

ITER ポロイダル偏光計遠赤外線 レーザー及び検出器の製作

Manufacturing of FIR Lasers and Detectors for ITER Poloidal Polarimeter

仕様書

国立研究開発法人量子科学技術研究開発機構
那珂フュージョン科学技術研究所
ITERプロジェクト部 計測開発グループ

目次

1 一般仕様.....	3
1.1 件名	3
1.2 目的及び概要	3
1.3 契約範囲.....	3
1.4 納期	3
1.5 納入場所及び納入条件.....	3
1.6 納入物	3
1.7 検査条件.....	3
1.8 提出図書.....	4
1.9 支給品及び貸与品	4
1.10 品質保証.....	4
1.10.1 一般事項.....	4
1.10.2 品質保証に関する要求.....	4
1.10.3 品質保証に関する情報の入手	7
1.10.4 品質計画書（Quality Plan: QP）について	7
1.10.5 トレーサビリティ	7
1.10.6 品質監査について	8
1.10.7 提出図書の文書管理.....	8
1.10.8 逸脱許可申請（Deviation Request）	8
1.10.9 不適合時の処理	9
1.11 情報セキュリティの確保.....	11
1.12 知的財産権及び技術情報等の取扱い.....	11
1.13 イーター調達に係る貨物の免税輸入について.....	11
1.14 グリーン購入法の推進.....	11
1.15 コンピュータプログラムの作成について	11
1.16 打合せについて	11
1.17 月例報告書.....	12
1.18 協議	12
1.19 下請け業者への業務委託について.....	12
1.20 適用法規・規格等	12
2 技術仕様.....	14
2.1 概要	14
2.1.1 遠赤外線レーザーおよびその付帯機器について	14
2.1.2 検出器について	15
2.1.3 本契約開始から完了までの流れ.....	15
2.2 遠赤外線レーザーの製作及び付帯機器の調達について.....	16
2.3 検出器の調達に関する仕様	19
2.4 搬入作業に関する仕様.....	19

別表 1	提出図書一覧.....	20
付録 1	適用すべき ITER 文書.....	22
付録 2	別添図書一覧.....	23

1 一般仕様

1.1 件名

ITER ポロイダル偏光計遠赤外線レーザー及び検出器の製作

1.2 目的及び概要

イーター計画において、国立研究開発法人量子科学技術研究開発機構（以下「QST」という。）はポロイダル偏光計を調達する。ポロイダル偏光計（略称 PoPola）は、遠赤外線レーザー光の偏光状態（偏光方位角、楕円率角）の測定に基づき、ITER のプラズマ中心部における電流分布の計測を行う装置である。計測室から出射した偏光測定用レーザー光（レーザー波長 $118.8 \mu\text{m}$ ）は、伝送光学系で伝搬された後、真空容器内のプラズマに入射され、真空容器内に設置されたレトロリフレクタで反射され、往路と同じ光路にて計測室まで伝送される。本件はこのポロイダル偏光計測に使用する遠赤外線レーザー及び検出器の製作に関する契約である。

1.3 契約範囲

- (1) 遠赤外線レーザーの製作
- (2) レーザー制御用 PC 及び制御用ソフトウェアの製作
- (3) 検出器の製作
- (4) 提出図書（1.8 項）の作成

1.4 納期

令和 12 年 2 月 28 日

1.5 納入場所及び納入条件

- (1) 納入場所

QST 那珂フュージョン科学技術研究所 先進計測開発棟

- (2) 納入条件

持込渡し

1.6 納入物

- | | |
|--------------------------------|-------|
| (1) 1.8 項に定める提出図書（紙媒体及び電子ファイル） | 一式 |
| (2) 遠赤外線レーザー | 2 セット |
| (3) レーザー制御用 PC 及び制御用ソフトウェア | 1 セット |
| (4) アルコールガス供給装置 | 1 台 |
| (5) 検出器 | 3 セット |

1.7 検査条件

QST 職員が製作物の員数及び提出図書を確認し、かつ、本仕様に定める作業がなされたことを確認した時をもって検査合格とする。

1.8 提出図書

受注者は別表 1 に示す図書を作成すること。提出図書は、紙媒体の他、電子ファイル（ワードファイルやエクセルファイル、dxf ファイル、STEP ファイルなど編集可能な元ファイル）を CD-ROM 等のメディアに格納して提出すること。

提出図書の確認方法は以下の方法で行う。QST は、確認のために提出された図書を受領したときは、期限日を記載した受領印を押印して返却する。また、当該期限までに審査を完了し、受理しない場合には修正を指示し、修正等を指示しないときは、受理したものとする。

ただし、再委託承諾願については、QST が確認後、書面で回答する。

1.9 支給品及び貸与品

(1) 支給品

なし

(2) 貸与品

CAD 図面（CATIA 形式、STP 形式、IGES 形式にて貸与可能）

貸与時期：契約締結後速やかに

貸与方法：電子メール又は QST が管理するオンラインストレージサーバを用いる。

返却方法：契約終了までに貸与したデータを削除すること。

1.10 品質保証

1.10.1 一般事項

- (1) 受注者は下記の項目を保証するよう適切な実施可能な品質システムを遂行すること。
 - 1 契約要求事項に実施内容が合致していること。
 - 2 規格等に準拠していることを示す証拠が維持/保存されること。
- (2) 受注者の遂行する上記の品質システムは下記を満たすこと。
 - 1 認証された品質規格に基づくものであること。
 - 2 契約に基づき実施される製作及び試験検査等の全ての行為を網羅するものであること。
 - 3 作業の開始に際して、QST に提出する品質計画書に記載されていること。
- (3) 受注者は、再委託先についても有効な品質システムを備えることを保証すること。再委託先業者がこれを満たさなかった場合、受注者は再委託先の施設等において品質を確立/維持するために必要な全ての活動の責任を負うものとする。

1.10.2 品質保証に関する要求

品質保証については、「イーター調達取決めに係る調達契約の品質保証に関する特約条項」（別添図書 1）に定められたとおりとする。

本契約の設計対象機器の各種等級は品質クラス 3（QC3）であり、品質分類の等級に基づく要求事項は表 1 及び表 2 のとおりとする。

表 1 品質分類の等級に基づく要求事項（灰色部分が本件に適用される）

	品質クラス 1、 2 (QC1,2)	品質クラス 3 (QC3)
設計	設計レビューと独立検証を含む設計管理	当事者間の他の合意が無い限り、設計レビュー及び独立検証は不要
ソフトウェア／モデル	ライフサイクル管理を含む設計、運転に使用するソフトウェア及びモデルの許容 使用するソフトウェアの同定とモデルの使用の評価	当事者間の他の合意が無い限り不要
調達／文書・記録	品質計画書(Quality Plan)	品質計画書(Quality Plan)
	検査・試験計画書 (Inspection Plan)	当事者間の他の合意が無い限り不要
	適合基準のレビュー 特殊工程のクオリフィケーションのレビュー	
	製作関連図書 (納入時)	
	規格基準に基づくコンプライアンス宣言、材料証明及び検査図書(納入時)	規格基準に基づくコンプライアンス宣言、材料証明及び検査図書
	リリースノート(所有権移転時)	リリースノート(所有権移転時)
	完成図書(所有権移転時)	完成図書(所有権移転時)
製作	製作・検査計画書(MIP)	当事者間の他の合意が無い限り不要
	製作レビュー(MRR)	
品質管理	QC1 は表 2 の QCL1 を適用。 QC2 は表 2 の QCL2 を適用。	QC3 は表 2 の QCL3 を適用。
建設、据付、アセンブリ	検査計画書	検査計画書
	建設レビュー	建設レビュー
品質監査	メーカーでの受注者監査	当事者間の他の合意により省略 あるいは 文書レビューによる確認
製品の納入・輸送	リリースノート	リリースノート
	輸送通知書	輸送通知書
	輸送計画書	当事者間の他の合意が無い限り不要
	サンプリング等による最低限の検査・検証 QST の要求又は製作者の手順書に基づく保管・保存	
	注記: (1) クラス 4 のシステム及び機器は特段の QA 要求事項はない。 (2) ‘独立’ とは、基の設計者に含まれない個人、グループ、部署、部門を意味する。‘独立’はまた第三者機関を指してもよい。	

表 2 品質分類に基づく検査・確認ポイント（灰色部分が本件に適用される）

項 目	品質管理レベル（QCL）		
	レベル 1	レベル 2	レベル 3
製作レビュー（MRR）	・ MRR 実施時	・ MRR 実施時	—
材料調達	・ 基準を満たさない場合に重大なリスクを及ぼす可能性がある場合	—	—
（新しい手法などの）重要とみなされる特殊作業手順（成形、切削、熱処理など）	・（曲げ加工等の）基準を満たさない場合に重大なリスクを及ぼす可能性がある場合（プロセスの認定用） ・ 初回検査 ・ 定期的な検査	・ 初回検査 ・ 基準を満たさない場合に重大なリスクを及ぼす可能性がある場合	・ 基準を満たさない場合に重大なリスクを及ぼす可能性がある場合
溶接方法	・ 溶接認証のモックアップ確認試験（スポットチェック） ・ 溶接認証（WPQR, WPQ など）	—	—
	・ 溶接の重要作業（仮組、初回活動、溶接材料の保管状態、溶接記録確認など）	・ 重要で前例のない初回の作業（仮組、初回活動、溶接材料の保管状態、溶接記録確認など） ・ その後、ランダムに確認	
非破壊検査（NDT）及び関連プロセス	・ NDE の重要な作業（加工・成形後の VT/DT/PT/UT、溶接前・中・後の VT/DT/PT/UT/RT など）	・ 重要で前例のない初回の作業（加工・成形後の VT/DT/PT/UT、溶接前・中・後の VT/DT/PT/UT/RT など） ・ その後、ランダムに確認	
	メーカーによる検査完了後の解析報告を含む変更履歴資料のレビューと承認		
補修方法	補修の難易度による補修作業と検査への立会	・ 基準を満たさない場合に重大なリスクを及ぼす可能性がある場合	
最終目視検査・寸法チェック	重大なリスクがあると判断された場合	重大なリスクがあると判断された場合	—
特殊試験（リーク試験、モーター動作試験など）	重大なリスクがあると判断された場合		
圧力強度試験	PE 及び NPE ^(*) が適用される場合で、重大なリスクがあると判断された場合		
最終受入試験（FAT）	重大なリスクがあると判断された場合		
清掃、酸洗、表面安定化処理、取扱・梱包、輸送、保管	・ 基準を満たさない場合に重大なリスクを及ぼす可能性がある場合	—	—

注記：（*）本契約で製作する機器は、フランスの圧力容器規制（PE）及び原子力圧力容器規制（NPE）が適用されない。

1.10.3 品質保証に関する情報の入手

- (1) 本仕様に関し、QST（及びイーター機構を含む。）は書面による通知を行うことにより、受注者（受注者の再委託先も含む。）の施設等において、作業の進捗状況確認及び試験検査に立ち会う権利を有するものとする。なお、上記を実施する日時については協議の上、決定する。
- (2) 受注者（受注者の再委託先も含む。）は QST（及びイーター機構も含む。）に対し、その要求があった場合、本契約の適切な管理運営を証明するために必要な文書及びデータを提供又は提示するものとする。

1.10.4 品質計画書（Quality Plan: QP）について

受注者は、本仕様書による要求事項をどのように満足させるかを示す、品質計画書をイーター機構指定様式（“QP Template for suppliers and subcontractors”）（別添図書 7）で英語により作成し提出すること。品質計画書には、次の内容を含む。

- ・ 品質目標・適用範囲
- ・ 品質保証体制（資源配分、義務、責任、権限など）
- ・ 図書管理
- ・ 製造管理（適用される手順、方法、指示など）
- ・ 記録及びその管理方法
- ・ 変更管理
- ・ 不適合管理
- ・ 公式及び非公式の情報交換の方法

品質計画書は、原則として受注者のみならず品質に係る重要業務を実施する下請け業者を含む供給者が提出しなければならない。品質に係る重要業務については、QST と受注者の協議の上決定する。契約締結後速やかに、QST へ品質計画書を提出し確認を受けなければならない。ただし、下請け業者の品質計画書は、下請け業者決定後 2 週間以内に QST へ提出し確認を受けること。QST は、イーター機構の了解を得るために、供給者の品質計画書をイーター機構へ提出する。品質計画書を変更しようとする場合、品質計画書を再提出し、QST の確認を得ること。この確認を得てから変更した品質計画書に基づき製作や作業を開始すること。

詳細は“Quality Requirements for IO Performers”（別添図書 8）を参照のこと。

1.10.5 トレーサビリティ

- (1) トレーサビリティの対象は、材料・購入部品・図書・検査とする。
- (2) 材料に関しては適切に確認できるよう、材料ブロックごとに識別コード付けをする等の方法により使用材料の発注責任者、発注仕様書、保管記録に関するトレーサビリティを確保するとともに、全ての製作段階においてトレーサビリティを維持すること。
- (3) 購入部品は、発注責任者、発注仕様書、保管記録のトレーサビリティを確保すること。
- (4) 図書は、著者、審査者、承認者、変更経歴のトレーサビリティを確保すること。
- (5) 検査は、検査者、検査日時、検査場所、検査機器の校正証明書・トレーサビリティ体系図、検査成績書の著者・審査者・承認者のトレーサビリティを確保すること。

1.10.6 品質監査について

- (1) QST は、本契約締結後 1 年以内に受注者の品質保証に係る監査を行う。
- (2) 前回の監査から 14 月以内に再度監査を実施する。
- (3) 2 回目以降の監査では、対象分野を限定して実施する。
- (4) 受注者が品質に係る重要業務をアウトソースする場合は、必要に応じて当該業務のアウトソース先の業務の実施状況の確認も本監査に含むことができるものとする。
- (5) 監査の時期及び実施する範囲は、監査を実施する少なくとも 14 日より前に受注者に通知されるものとする。

1.10.7 提出図書の文書管理

文書管理は受注者の品質マネジメントシステムに従うものであるが、それに加えて以下に定める文書番号及び電子版の送付方法に従うこと。

JADA 文書番号の付け方

提出図書及びその別添図書並びに打合せ資料は JADA（イータープロジェクト 日本国内機関）の文書番号を表紙右上に記載すること。JADA 文書番号は「JADA-55353XX3yyy-r」という様式であり、ここで XX はアルファベットを、yyy は数字を、r は改訂番号（初版には-rをつけない）を表している。それぞれの提出図書に対する分類記号（上記の XX の部分）及び yyy のうち数字が指定されているものについては別表 1 に従うこと。yyy のうち数字が指定されていないものについては受注者が管理する通し番号である。受注者は JADA 文書管理番号一覧（自由書式）を作成し、yyy の通し番号に重複が生じないように管理すること。採番する文書番号を確定する前に、QST の了解を得ること。

送付方法について

- (1) JADA 文書番号を付与した図書は全て、QST 担当者及び JADA 文書管理センター（iter-dmc@qst.go.jp）にメール送付すること。
- (2) ドラフト版の場合は QST 担当者のみにメール送付し、JADA 文書管理センターにはメール送付しないこと。
- (3) メール本文内において、受注者の文書番号、JADA 文書番号及び文書名を記載すること。

1.10.8 逸脱許可申請（Deviation Request）

1.10.8.1 受注者側からの申請

性能の変化を生じさせない仕様変更を受注者が要望する場合、Procedure for the management of Deviation Request（別添図書 9）に記載された手続きに従って、Deviation Request（逸脱要求）を発行し、QST の承認を得なければならない。なお、Deviation Request を発行する際は、Deviation Request が QST の承認を得るまで関連する作業を行ってはならない。

受注者が Deviation Request を発行してから終了するまでの流れを以下に示す。

① 受注者による Deviation Request の発行

受注者は、Deviation Request Template（別添図書 10）のテンプレートを用いて Deviation Request を作成する。Deviation Request はイーター機構に対して発行される前にまず受注者内でのレビューを行い、受注者のラインマネージャーがその Deviation Request を承認する。その後、受注者は Deviation Request を QST に提出する。

② レビュー

QST は受注者から発行された Deviation Request のレビューをイーター機構とともに行う。

③ 承認するかどうかの判定

Deviation Request が却下された場合、受注者は要求を満たし、かつ逸脱を要求しない代替案を考案する。代替案が提案できない場合、受注者はその決定に異を唱え、また、関係者に解決策に対する助言を求めることができる。

④ Deviation Request の終了

受注者は Deviation Request の決定を関係者すべてに確実に周知し、必要な修正処置を確実に行うこと。また、影響を受けるすべての図書を Deviation Request の書式に確実に記録すること。また、Deviation Request の承認によってさらに重大なアクションが引き起こされる場合や、Deviation の実行を反映するために関係する図書を改訂する必要がある場合には、受注者は Deviation Request に記載された事項の実行（つまりは、当該アクションの完遂及び当該図書の改訂）を確認しなければならない。Deviation Request 記載事項の実行の確認が要求される場合、受注者は実行を正当化するすべての証拠を添付しなければならない。

以上の流れについて、詳細は Procedure for the management of Deviation Request（別添図書 9）に従うこと。

1.10.8.2 イーター機構側からの Deviation Request

イーター機構側から Deviation Request が出された場合は、受注者は QP に記載の手続きに従い変更を社内に確実に周知すること。また、1.10.8.1 に記載の④Deviation Request の終了の手続きについても同様に従うこと。

1.10.9 不適合時の処理

不適合事象（Non-conformities。以下「NC」と言う。）が発生した場合、受注者は Procedure for management of Nonconformities（別添図書 11）の手続きに従うこと。同 procedure に記載された作業フローの概要は以下のとおりである。

- ① 要求に対する不適合を詳細かつ明確に記述し、まず QST 及びイーター機構に、それから各関係者にできる限り早く通知する。（イーター機構が、内部不適合だと判断し、NC の開始を止めることもある）

- ② イーター機構の NC システムに今回の NC を登録する。
- ③ NC に対する決定が下されるまで、NC の対象の作業をイーター機構の了解を得たうえで停止する。
- ④ NC のカテゴリ分け及び修正案を書面で提案する。
- ⑤ イーター機構及び QST と正式な通信手段において話し合い、NC のカテゴリ分けと修正案について結論を出す。
- ⑥ NC に対する処置の進捗を QST 及びイーター機構に適切な時期に証拠とともに提出する。
- ⑦ できる限り早く NC に対する処置のための問題解決手法(RCA(Root Cause Analysis)や初期の原因分析を含む)を開始する。このとき受注者はイーター機構に問題解決の手法についての支援を求めることができる。
- ⑧ イーター機構が要求する情報について補足し、NC を独自のシステムで管理する。

受注者が NC を発見した場合、①、②に関しても受注者が行う（ただし、イーター機構への通知内容や NC システムへの登録内容は事前に QST と合意を得ること）。受注者以外が NC を発見した場合は①、②はすでになされているので③からを行う。

作業フロー④におけるカテゴリとは、Major NC か Minor NC かであり、NC の与える影響に応じて、同 Procedure に沿って分類される。分類については受注者とイーター機構及び QST の間の話し合いによって決定する。

作業フロー⑥の NC に対する処置はその内容によって変わるため、ここで製品 NC とプロセス NC という言葉を定める。製品 NC とは、満足していない要求が製品の特性などに関係するものであり、プロセス NC とは満足していない要求が作業の特定の方法などに関するものである。製品 NC に対する処置は、以下の中から採用する。

- ・そのまま使用
- ・手直し
- ・修理
- ・却下
- ・図書の変更または発行

また、プロセス NC に対する処置は、以下の中から採用する。

- ・そのまま使用
- ・却下
- ・図書の変更または発行

NC の終了は、納入の時点で製品に対する要求が満たされているということを保証するものでなければならない。従って、Minor NC の終了のためには、処置が全て履行された証拠が必要であり、Major NC の終了の為には、処置が全て履行された証拠だけでなく RCA の結論なども必要である。

以上の手続きの詳細について、Procedure for management of Nonconformities（別添図書 11）に従うこと。

1.11 情報セキュリティの確保

情報セキュリティの確保については、『本契約において遵守すべき「情報セキュリティの確保」に関する事項』（別添図書 2）に示すとおりとする。

1.12 知的財産権及び技術情報等の取扱い

(1) 知的財産権等の取扱い

知的財産権等の取扱いについては、「知的財産権等の取扱いについて」（別添図書 3）及び「イーター実施協定の調達に係る情報及び知的財産に関する特約条項」（別添図書 4）に示すとおりとする。

(2) 技術情報

受注者は、本契約を実施することによって得た技術情報を第三者に開示しようとする際には、あらかじめ書面による QST の承認を得なければならない。

QST が本契約に関し、その目的を達成するため受注者の保有する技術情報を了知する必要が生じた場合は、QST と受注者の協議の上、受注者は当該技術情報を無償で QST に提供すること。

(3) 成果の公開

受注者は、本契約に基づく業務の内容及び成果について、発表若しくは公開し、又は特定の第三者に提供しようとする際は、あらかじめ書面による QST の承認を得なければならない。

1.13 イーター調達に係る貨物の免税輸入について

イーター調達に係る貨物の免税輸入については、「イーター調達に係る貨物の免税輸入について」（別添図書 5）に示すとおりとする。

1.14 グリーン購入法の推進

(1) 本契約において、グリーン購入法（国等による環境物品等の調達の推進等に関する法律）に適用する環境物品（事務用品、OA 機器等）が発生する場合は、これを採用するものとする。

(2) 本仕様に定める提出図書（納入印刷物）については、グリーン購入法の基本方針に定める「紙類」の基準を満たしたものであること。

1.15 コンピュータプログラムの作成について

コンピュータプログラムの作成については、『コンピュータプログラム作成等業務特約条項』（別添図書 6）に示すとおりとする。

1.16 打合せについて

打合せの実施にあたっては、以下の要領に従うこと。

(1) 受注者は、原則として 1 ヶ月に一度以上の頻度で、QST 担当者と打合せを実施すること。

- (2) 打合せに使用する資料は 1.10.7 項の文書管理の要領に従うこと。
- (3) 打合せ資料の一部として最新の情報を反映したパンチリストと工程表のドラフト版を提示すること。(ただし、パンチリストと工程表の正式な改訂版は 1.17 項に従い毎月末に月例報告書として提出する。)
- (4) 打合せ後、2 週間以内（土日祝日を含む）に受注業者内で審査・承認を通過した議事録を提出すること。

1.17 月例報告書

受注者は、契約の全期間に渡り、毎月末に月例報告書（書式自由）を作成し、QST に提出すること。記載内容は以下の事項を含むこと。

- (1) 当該一ヵ月における進捗。報告事項は、材料や機器の発注状況、製品の製作や検査の実施状況及び製品に関する図書の作成状況である。また、単なる状況報告（例えば、「図書〇〇の作成を仕掛中」といった報告）とはせずに、図書作成をする上で検討したこと（例えば、治具や溶接施工方法の検討内容や、下請け業者との協議事項など）や検討のために実施した社内試作の内容を、図や写真を用いて具体的に報告すること。
- (2) 翌月に予定される代表的な作業項目。
- (3) 作業工程表（別表 1 参照）及びパンチリストの最新版。
- (4) JADA 文書管理番号一覧表の最新版（更新がある場合のみ）。

1.18 協議

本仕様書に記載されている事項及び本仕様書に記載のない事項について疑義が生じた場合は、QST と協議の上、その決定に従うものとする。

協議の内容及び結果、QST からの質問に対する回答など、受注者と QST の間の伝達事項をエビデンスとして残す場合は、連絡票という図書として提出すること。また、連絡票は 1.10.7 に記載の文書管理に従うこと。

1.19 下請け業者への業務委託について

受注者が下請け業者に業務を委託する場合は、その業務委託仕様書の英語版を提出し、イーター機構による審査及び QST の確認を受けること。また、再委託先の作業開始 2 週間前までに QST 指定様式の再委託承諾願を提出すること。QST が業務委託仕様書と再委託承諾願の両方を受領した後、書面をもって回答する。受注者は、QST から承諾書を受領した後に、下請け業者と契約を結んでよいものとする。

下請け業者と契約を締結した後は、契約したことの通知書、下請け業者の名称及び住所を記載した書類を提出すること。

下請け業者の QP については 1.10.4 項に従うこと。

1.20 適用法規・規格等

- (1) 欧州指令（RoHS 指令（2011/65/EU）、機械指令（2006/42/EC）低電圧指令（LVD）（2014/35/EU）、EMC 指令（2014/30/EU）など）

- (2) EC 規則 (REACH 規則 (Regulation (EC) No 1907/2006)、ODS 規制 (Regulation (EC) No 1005/2009)、F ガス規則 (Regulation (EU) No 517/2014) など)
- (3) EN 60825 Safety of laser products
- (4) IEC 60825-1:2014 Safety of laser products

2 技術仕様

2.1 概要

2.1.1 遠赤外線レーザーおよびその付帯機器について

ITER ポロイダル偏光計は、波長 $119\ \mu\text{m}$ の遠赤外線レーザーをプラズマに入射し、そのレーザーの偏光状態の変化を測定する。そして、ポロイダル偏光計だけでなく他の計測装置の計測データとも合わせて解析することで、プラズマ中の磁場分布を推定することができる。

本件では、遠赤外線レーザー2セットに加えて、同レーザーを制御するためのPC1セット（PC内に実装するソフトウェアも含む）と同レーザーにアルコールガス（メタノールの蒸気）を供給するためのアルコールガス供給装置1台も製作する。遠赤外線レーザーには、レーザー共振器だけでなく高電圧電源やチラーなどが含まれる。図1は、本件で受注者が製作する遠赤外線レーザー及びその付帯機器の全体像を示している。図1中の実線は電力・電気信号のつながりがあることを示している。チラー及びアルコールガス供給装置は制御用PC及びレーザー制御用PLCとは接続されておらず、独立した運転を行う。

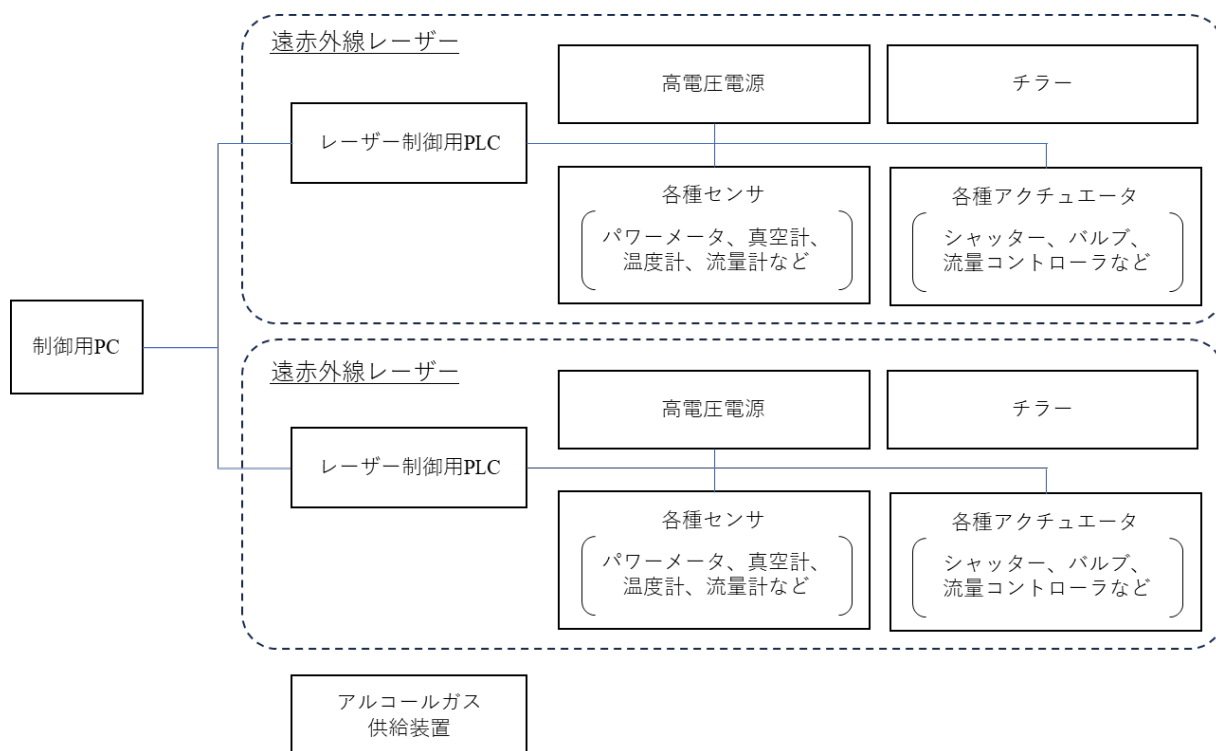
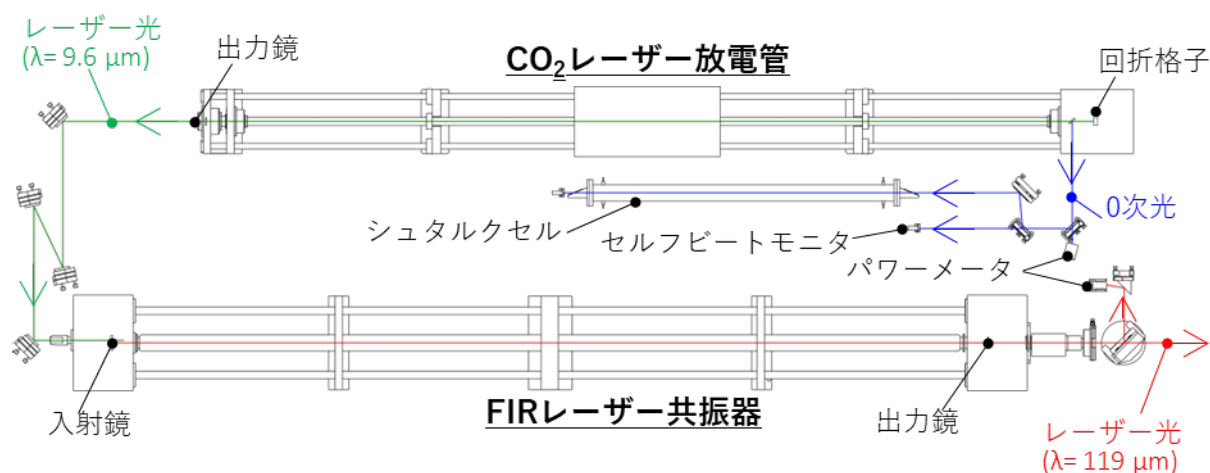


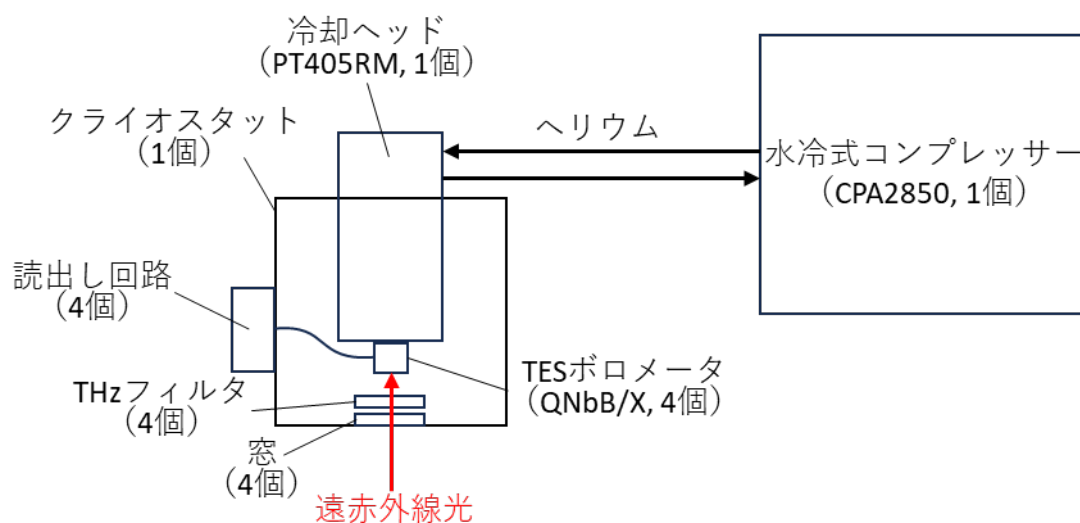
図1 遠赤外線レーザー及びその付帯機器の全体像

図2は、遠赤外線レーザー装置のうちレーザー光に直接関係する機器を示している。炭酸ガス（以下「CO₂」という。）レーザー放電管で波長 $9.6\ \mu\text{m}$ のレーザー光を生成し、遠赤外線（以下「FIR」という。）レーザー共振器に入射する。FIR レーザー共振器内部にはアルコールガスが供給されており、レーザー光の波長が $9.6\ \mu\text{m}$ から $119\ \mu\text{m}$ へ変換される。



2.1.2 検出器について

ポロイダル偏光計では、遠赤外線領域で高い感度を有する遷移エッジ超伝導 (TES) ボロメータを使用する。TES ボロメータはクライオスタット、冷却ヘッド、コンプレッサーなどと共に使われ、本仕様書ではこれらをまとめて検出器と称す。図 3 は検出器 1 セット分の概要を示している。本件では、検出器を 3 セット調達する。



2.1.3 本契約開始から完了までの流れ

本契約開始から完了までの流れを、図 4 にフローチャートとして示した。受注者は、QP が QST により確認された後に、作業を行うこと。製作確認図、検査要領書、発注仕様書については 2.2 項～2.3 項の仕様に従うこと。

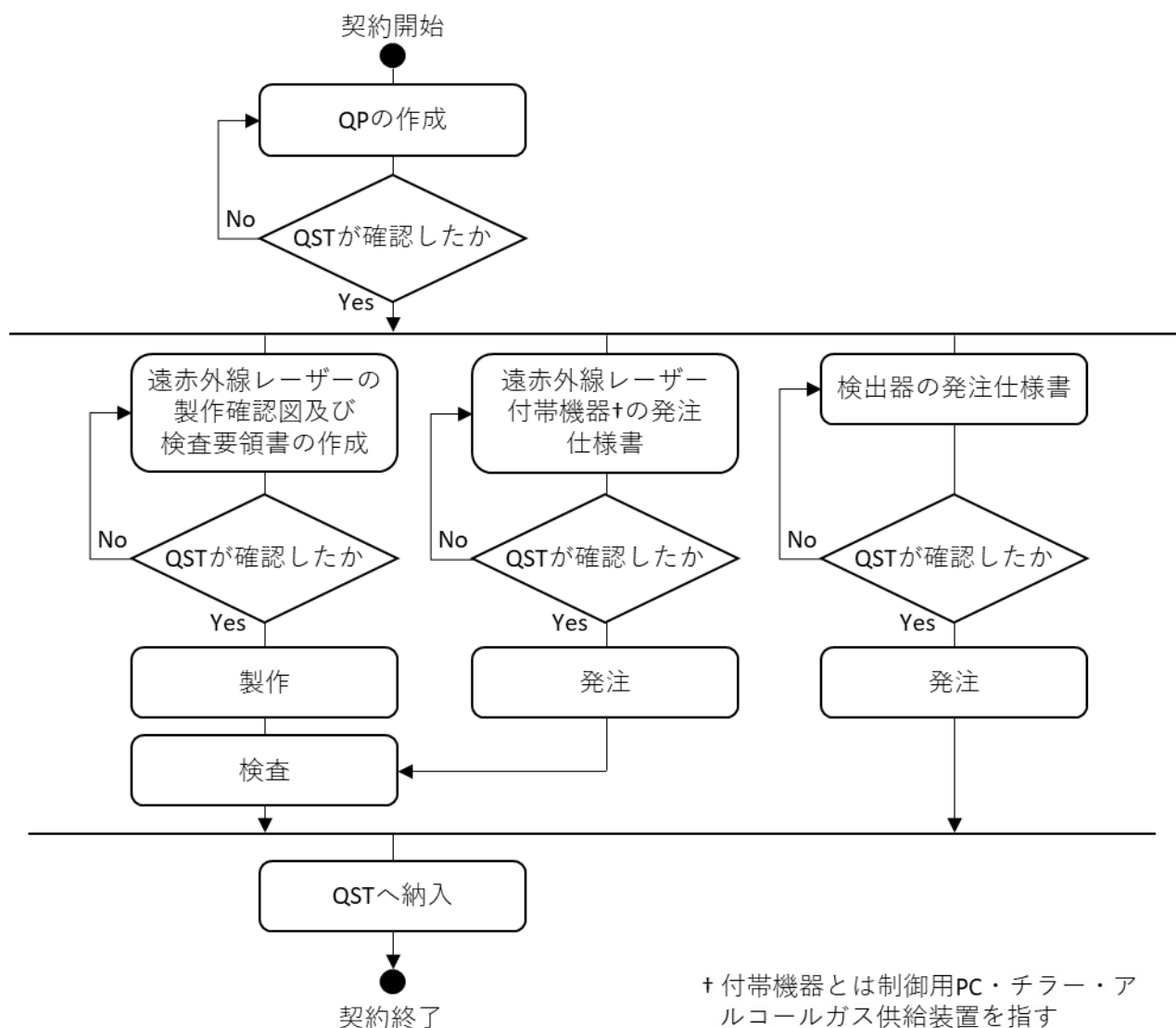


図 4 本契約開始から完了までのフローチャート

2.2 遠赤外線レーザーの製作及び付帯機器の調達について

遠赤外線レーザーの図面や部品リスト、各種系統図は別添図書 1 2 に記載されている。受注者は別添図書 1 2 に従って遠赤外線レーザーを製作すること。制御用 PC に求められる機能も別添図書 1 2 に記載されており、受注者は制御用 PC に実装するソフトウェアを製作すること。制御用 PC は ECRIN 社製 ID01549-A-006（図 5 参照）を用いること。同 PC は受注者が手配するものであり、本件の納入物の一部である。ソフトウェアのソースコードも納入物であり、制御用 PC に格納すること。

概要の図 1 においてチラーは遠赤外線レーザーの一部（点線の内部）として描かれているが、別添図書 1 2 にチラーの情報は記載されていない。チラーは Thermo Fisher Scientific 社製 ThermoFlex TF10000（相当品可、諸元は表 3 の通り）を用いること。同チラーは受注者が手配するものであり、本件の納入物の一部である。

アルコールガス供給装置の仕様は、別添図書 1 3 に記載されている。受注者は別添図書 1 3 に従ってアルコールガス供給装置を手配すること。

	ID01549-A-006 ITER/I&C_GRADE	
Xeon E3-1275v6 industrial computer - DDR3 ECC 16GB, 2xGbE, SSD 2x64Go, PICMG 1.3 backplane, 800W+800W redundant PSU - 19" 4U rackmount system include :		
DESIGNATION	Qty.	
4U Rackmount Industrial chassis with 14 slot backplane - Depth. 450 mm, PS2 form factor Power Supply, drive bays 2x5"1/4 - Embedded MMI, Fans&Temperature monitoring . Black color.	1	
800W High efficiency Mini Redundant AC/ATX Power Supply (MRG-5800V4V for OPALE_V2)	1	
PICMG 1.3 Server Class 14 slots backplane - 1xSHB / 1xPCIe x8 / 3xPCIe x4 / 8xPCI	1	
SHB TKL - Xeon E3-1275v6 (4C/8T, 3.8GHz, 8Mo cache, TDP 73W), PCIe Gen3	1	
DIMM DDR4 2400MHz 8G E TR	2	
3"1/2 to 5"1/4 adapter - black	1	
2x2"1/2 SATA HDD in 3"1/2 drive bay.	1	
SSD 2"1/2 SATA 6Gb/s - 3SE2-P_AES, SLC, DRAM buffer, iSMART, 0~70°C - 64GB	2	

図 5 制御用 PC の仕様

表 3 チラーの諸元

温度設定範囲： 5 度～90 度
室温範囲：10 度～40 度
温度安定性：+/-0.1 度
冷却能力：10000W (60Hz)、8500W (50Hz)
電力供給：208-230V, 60Hz, 3 相
400V, 50Hz, 3 相
400-460V, 50-60Hz, 3 相
寸法：639x856x1327 (W)x(D)x(H)mm

受注者は遠赤外線レーザーの製作を開始する前に、製作確認図及び検査要領書を作成すること。製作確認図及び検査要領書が 1.8 項に記載した確認方法で確認された後に、受注者は製作を開始してよい。製作確認図を英語で作成し、以下の内容を含めること。

- (1) 光学機器配置図
- (2) 真空系統図
- (3) 圧縮空気系統図
- (4) 冷却水系統図
- (5) 制御系展開接続図
- (6) 単線結線図
- (7) 制御盤外観図
- (8) 端子配列図
- (9) 部品リスト
- (10) 製作図面

(11) 制御用 PLC の機能仕様書および技術仕様書（信号リストを含む）

(12) インターロック条件書

(13) 制御用 PC の機能仕様書および技術仕様書（変数リストを含む）

受注者は試験検査要領書（検査図面を含む）を英語で作成し、以下の検査を実施するための要領を記載すること。

(1) 寸法検査

(2) 水路耐圧試験：水圧テストポンプで 0.2MPa を 30 分以上印加し、圧力計の指示値が下がらないこと。

(3) 真空リークテスト：CO₂ レーザー管の到達圧力が 10 Pa 以下、FIR 共振器の到達圧力が 3 Pa 以下、シュタルクセルの到達圧力が 3 Pa 以下であること。

(4) 導通及び絶縁検査：CO₂ レーザー管は DC10kV 印加時に絶縁抵抗値が 25MΩ 以上、シュタルクセルは DC2kV 印加時に絶縁抵抗値が 25 MΩ 以上あること。

(5) 動作確認試験

(ア) ガス圧制御動作確認試験：

① CO₂ 混合ガスを 0.1～2 slm の範囲で供給できること。

② ヘリウムガスを 0.1～4 slm の範囲で供給できること。

③ メタノールガスを 0.1～4.5 sccm の範囲で供給できること。

(イ) 温度管理動作確認試験：冷却水温度を 13 度～17 度の範囲で設定できること。

(ウ) 遠隔操作確認試験：制御 PC から FIR レーザーを発振させられること。

(エ) インターロック動作確認試験：インターロック条件書に記載されたインターロックが動作すること。

(6) レーザー発振試験

(ア) 励起用 CO₂ レーザーの発振試験：波長 9.6 μm、出力 150 W のレーザー光が出力されること。

(イ) FIR レーザーの発振試験：波長 119 μm のレーザー光が出力されること。また、図 2 において「レーザー光（λ=119 μm）」と注釈が入っている場所においてレーザーパワーが 600 mW 以上であること。

(7) 周波数安定度試験：FIR レーザーを 600 mW 以上で出力しているときの 10 分間の周波数安定度を測定すること。

(8) 外観検査

(9) 員数検査

受注者は、遠赤外線レーザーの付帯機器（制御用 PC、チラー及びアルコールガス供給装置）を発注する前に、発注仕様書（英語）を作成すること。発注仕様書が 1.8 項に記載した確認方法で確認された後に、受注者は付帯機器の発注を開始してよい。もし、遠赤外線レーザーの製作確認図が確認される前に一部の部品を先行手配したい場合は、受注者は同様に発注仕様書（英語）を作成し、1.8 項に記載した方法で確認を得た後に同部品を手配して良い。

受注者は、遠赤外線レーザーとその付帯機器を使用し、QST が確認した検査要領書に則って検査を行うこと。検査後は、検査の結果を検査成績書（英語）に記載して提出すること。

受注者は遠赤外線レーザーのマニュアルを作成するとともに、すべての構成部品のマニュアル（例えばマスフローコントローラのマニュアル）も提出すること。遠赤外線レーザーのマニュアルには、製作確認図に記載した内容や受注者が制御用 PC 及び制御用 PLC に実装した機能の使用方法だけでなく、遠赤外線レーザーの組み立て方法及び保守方法、消耗品リストも記載すること。

2.3 検出器の調達に関する仕様

検出器の仕様は別添図書 1 4 に記載されている。受注者は検出器を発注する前に、発注仕様書（英語）を作成すること。発注仕様書が 1.8 項に記載した確認方法で確認された後に、受注者は検出器の発注を開始してよい。受注者は、検出器メーカーが作成する検査成績書を QST に提出すること。

2.4 搬入作業に関する仕様

1.5 項にある通り納入条件は持込渡しである。QST への搬入作業をする際は以下の事項を遵守すること。

- (1) 受注者は、事前に作業内容・作業日時・作業体制について QST と協議し、合意を得ること。
- (2) 本作業を開始する前に、QST が行う保安教育訓練を受けること。
- (3) 作業の安全衛生管理は、法令に従い、受注者の責任において自主的に行うこと。
- (4) 受注者は、作業着手に先立ち QST と安全について十分に打合せを行った後、作業に着手すること。
- (5) 受注者は、作業現場の見やすい位置に、作業体制表及び非常時通報連絡系統図等を表示すること。
- (6) 作業中は、常に整理整頓を心掛ける等、安全及び衛生面に十分注意すること。
- (7) 搬入作業終了後は、梱包材を受注者負担で廃棄すること。

以上

別表 1 提出図書一覧

	図書名	和文/英文	JADA 文書番号	提出時期	部数	確認	備考
1	作業工程表	英文	JADA-55353WS3001	契約後速やかに	1 部	不要	
2-1	Quality Plan（契約者の品質計画書）	英文	JADA-55353PL3001	契約後速やかに	1 部	要	1.10.4 項参照
2-2	Subcontractor Quality Plan（重要工程を実施する再委託先の品質計画書）	英文	JADA-55353PL30yy	再委託先との契約後速やかに	1 部	要	1.10.4 項参照
3-1	打合せ資料	和文	JADA-55353GD30yy	打ち合わせまでに	1 部	不要	1.16 項参照
3-2	打ち合わせ議事録	和文	JADA-55353MI3yyy	打ち合わせ後 2 週間以内	1 部	不要	1.16 項参照
4	月例報告書	和文英文併記	JADA-55353PR3yyy	毎月月末までに	1 部	不要	1.17 項参照
5	JADA 文書管理番号一覧	和文	JADA-55353GD32yy	更新後速やかに	1 部	不要	1.10.7 項参照
6	Deviation Request	英文	JADA-55353DR3yyy	許可を要求する必要がある時、直ちに	1 部	要	1.10.8 項参照
7	不適合報告書	英文	JADA-55353NR3yyy	報告すべき事象が生じた時、直ちに	1 部	要	1.10.9 項参照
8	再委託承諾願（QST 指定様式）	和文	JADA-55353GD31yy	再委託先の作業開始 2 週間前までに	1 部	要	再委託先がある場合提出のこと
9	再委託先と契約したことの通知書（作業場所の情報も含む）	英文	JADA-55353GD31yy	再委託先の作業開始 2 週間前までに	1 部	不要	再委託先がある場合提出のこと
10	連絡票	和文	JADA-55353NO3yyy	必要が生じた場合速やかに	1 部	不要	協議の内容及び結果など、受注者と QST の間の伝達事項をエビデンスとして残す場合の書類
11	遠赤外線レーザーの製作確認図	英文	JADA-55353TS3001	遠赤外線レーザーの製作開始前までに	1 部	要	2.2 項参照

12	遠赤外線レーザーの検査要領書	英文	JADA-55353NP3001	遠赤外線レーザーの製作開始前までに	1 部	要	2.2 項参照
13	遠赤外線レーザーの検査成績書	英文	JADA-55353IR3001	納入時	1 部	不要	1.10.5 項参照
14	遠赤外線レーザーのマニュアル	英文	JADA-55353FD3001	納入時	1 部	不要	2.2 項参照
15	制御用 PC の発注仕様書	英文	JADA-55353PS3001	制御用 PC の発注前までに	1 部	要	2.2 項参照
16	チラーの発注仕様書	英文	JADA-55353PS3002	チラーの発注前までに	1 部	要	2.2 項参照
17	アルコールガス供給装置の発注仕様書	英文	JADA-55353PS3003	アルコールガス供給装置の発注前までに	1 部	要	2.2 項参照
18	検出器の発注仕様書	英文	JADA-55353PS3004	検出器の発注前までに	1 部	要	2.3 項参照
19	検出器の検査成績書	英文	JADA-55353IR3002	納入時	1 部	不要	2.3 項参照

以上

付録1 適用すべき ITER 文書

N	Applicable Document
1	Procedure for Analyses and Calculations (22MAL7 v6.8)
2	Procedure for Identification and Controls of Items (U344WG v2.2)
3	Quality Requirements for IO Performers (22MFG4 v6.3)
4	Procedure for management of Nonconformities (22F53X v9.1)
5	Procedure for the management of Deviation Request (2LZJHB v9.1)
6	Quality Classification Determination (24VQES v6.0)
7	Quality Management System Audits (2DQTA8 v5.0)
8	Health Protection and Safety General Coordination Plan - ITER Construction Site - Volume 0 - General Safety Rules (2NUEYG v6.0)
9	Internal Regulations (27WDZW v3.1)
10	Environmental requirements (97WRFP v2.2)
11	Contractor Safety Management Procedure (Q2GBJF v1.4)
12	Procedure for Occupational Health and Safety Hazard Identification and Assessment (AJLQRF v6.0)
13	00 - Nuclear Regulatory Framework for INB ITER (2WBB8P v3.8)
14	Order dated 7 February 2012 relating to the general technical regulations applicable to INB - EN (7M2YKF v1.7)
15	Overall Surveillance Plan of External Interveners Chain for Protection Important Components, Structures and Systems and Protection Important Activities (4EUQFL v8.2)
16	Safety Important Functions and Components Classification Criteria and Methodology (347SF3 v1.8)
17	ITER Policy on Safety, Security and Environment Protection Management (43UJN7 v3.1)
18	Guideline for Identification of the Protection Important Activities (PIA) (SBYJXD v1.4)
19	Provisions for Implementation of the Generic Safety Requirements by the External Interveners (SBSTBM v2.3)
20	Propagation of the Defined Requirements for Protection Important Components Through the Chain of External Interveners (BG2GYB v3.3)

以上

付録 2 別添図書一覧

- 別添図書 1 イーター調達取決めに係る契約の品質保証に関する特約条項
- 別添図書 2 本契約において遵守すべき「情報セキュリティの確保」に関する事項
- 別添図書 3 知的財産権特約条項
- 別添図書 4 イーター実施協定の調達に係る情報及び知的財産に関する特約条項
- 別添図書 5 イーター調達に係る貨物の免税輸入について
- 別添図書 6 コンピュータプログラム作成等業務特約条項
- 別添図書 7 QP Template for suppliers and subcontractors (ITER 文書番号 2MLX45 ver.1.1)
- 別添図書 8 Quality Requirements for IO Performers (ITER 文書番号 22MFG4 ver.6.3)
- 別添図書 9 Procedure for the management of Deviation Request (ITER 文書番号 2LZJHB ver. 9.1)
- 別添図書 10 Deviation Request Template (ITER 文書番号 2LRNQP ver.4.0)
- 別添図書 11 Procedure for management of Nonconformities (ITER 文書番号 22F53X ver.9.1)
- 別添図書 12 Technical Specification of PBS55.C6 FIR Laser System (ITER 文書番号 9ECN97 ver.1.0)
- 別添図書 13 Technical Specification of PBS.55.C6 PoPola Alcohol Gas Supply System (ITER 文書番号 9EBQLD v1.0)
- 別添図書 14 Technical Description of PBS55.C6 THz Detector and Cryocooler (ITER 文書番号 9H7JPS v1.0)

以上

別添－１『イーター調達取決めに係る契約の品質保証に関する特約条項』

本契約については、契約一般条項によるほか、次の特約条項（以下「本特約条項」という。）による。

（定義）

- 第１条 本契約において「協定」とは、「イーター事業の共同による実施のためのイーター国際核融合エネルギー機構の設立に関する協定」をいう。
- ２ 本契約において「イーター機構」とは、協定により設立された「イーター国際核融合エネルギー機構」をいう。
- ３ 本契約において「加盟者」とは、協定の締約者をいう。
- ４ 本契約において「国内機関」とは、各加盟者がイーター機構への貢献を行うに当たって、その実施機関として指定する法人をいう。
- ５ 本契約において「フランス規制当局」とは、イーター建設地であるフランスの法令に基づき契約物品に関して規制、許認可を行う権限を有する団体をいう。

（品質保証活動）

- 第２条 乙は、本契約書及びこの契約書に附属する仕様書（以下「契約書等」という。）の要求事項に合致させるため本契約内容の品質を管理するものとする。

（品質保証プログラム）

- 第３条 乙は、本契約の履行に当たっては、乙の品質保証プログラムを適用する。このプログラムは、国の登録を受けた機関により認証されたもの（ISO9001-2015 等）で、かつ、本特約条項に従って契約を履行することができるものとする。ただし、これによることができないときは、甲により承認を得た品質保証プログラムを適用することができる。

（品質重要度分類）

- 第４条 乙は、適切な製品品質を維持するため、安全性、信頼性、性能等の重要度に応じて甲が定める本契約内容の等級に従って管理を実施しなければならない。契約物品の等級及び等級に応じた要求事項は、仕様書に定める。

（疑義の処置）

- 第５条 乙は、本契約書等に定める要求事項に疑義又は困難がある場合には、作業を開始する前に甲に書面にて通知し、その指示に従わなければならない。

（逸脱許可）

- 第６条 乙は、契約物品について、契約書等に定める要求事項からの逸脱許可が必要と思われる状況が生じた場合は、当該逸脱許可の申請を速やかに甲に提出するものとする。甲は、乙からの申請に基づき、当該逸脱許可の諾否について検討し、その結果を乙に通知するものとする。

(不適合の処理)

第7条 乙は、契約物品が契約書等の要求事項に適合しないとき又は適合しないことが見込まれるときは、遅滞なくその内容を甲に書面にて通知し、その指示に従わなければならない。

(重大不適合の処置)

第8条 乙は、重大不適合が発生した場合、直ちにその内容を甲に報告するとともに、プロジェクトへの影響を最小限に抑え、要求された品質を維持するため、その処置方法を検討し、速やかに甲に提案し、その承認を得なければならない。

(作業場所の通知)

第9条 乙は、本契約締結後、本契約の履行に必要なすべての作業場所を特定し、本契約に係る作業の着手前に、甲に書面にて通知するものとする。当該通知には、本契約の履行のために、乙が本契約の一部を履行させる下請負人の作業場所を含む。

(受注者監査)

第10条 甲は、乙に対して事前に通知することにより、乙の品質保証に係る受注者監査を実施できるものとする。

(立入り権)

第11条 乙は、本契約の履行状況を確認するため、甲、イーター機構、本契約の活動に関連する日本以外の加盟者の国内機関、フランス規制当局及びそれらから委託された第三者が、第9条に基づき特定した作業場所に立ち入る権利を有することに同意する。

2 前項に定める立入り権に基づく作業場所への立入りは、契約書等に定める中間検査等への立会い及び定期レビュー会合への参加の他、乙に対して事前に通知することにより、必要に応じて実施することができるものとする。

(文書へのアクセス)

第12条 乙は、甲の求めに応じ、本契約の適切な管理運営を証明するために必要な文書及びデータを提供するものとする。

(作業停止の権限)

第13条 甲は、乙が本契約の履行に当たって、契約書等の要求事項を満足できないことが認められる等、必要な場合は、乙に作業の停止を命じることができる。

2 乙は、甲から作業停止命令が発せられた場合には、可及的速やかに当該作業を停止し、甲の指示に従い要求事項を満足するよう必要な措置を講ずるものとする。

(下請負人に対する責任)

第14条 乙は、下請負人に対し、本契約の一部を履行させる場合、本特約条項に基づく乙の一切の義務を乙の責任において当該下請負人に遵守させるものとする。

(情報のイーター機構等への提供)

第15条 乙は、本契約の履行過程で甲に伝達された情報が、必要に応じてイーター機構及びフランス規制当局に提供される場合があることにあらかじめ同意するものとする。

以上

別添－２『本契約において遵守すべき「情報セキュリティの確保」に関する事項』

- 1 受注者は、契約の履行に関し、情報システム（情報処理及び通信に関わるシステムであって、ハードウェア、ソフトウェア及びネットワーク並びに記録媒体で構成されるものをいう。）を利用する場合には、量研機構の情報及び情報システムを保護するために、情報システムからの情報漏えい、コンピュータウィルスの侵入等の防止その他必要な措置を講じなければならない。
- 2 受注者は、次の各号に掲げる事項を遵守するほか、量研機構の情報セキュリティ確保のために、量研機構 が必要な指示を行ったときは、その指示に従わなければならない。
 - (1) 受注者は、契約の業務に携わる者（以下「業務担当者」という。）を特定し、それ以外の者に作業をさせてはならない。
 - (2) 受注者は、契約に関して知り得た情報（量研機構に引き渡すべきコンピュータプログラム著作物及び 計算結果を含む。以下同じ。）を取り扱う情報システムについて、業務担当者以外が当該情報にアクセス可能とならないよう適切にアクセス制限を行うこと。
 - (3) 受注者は、契約に関して知り得た情報を取り扱う情報システムについて、ウィルス対策ツール及びファイアウォール機能の導入、セキュリティパッチの適用等適切な情報セキュリティ対策を実施すること。
 - (4) 受注者は、P2P ファイル交換ソフトウェア（Winny、WinMX、KaZaa、Share 等）及び SoftEther を導入した情報システムにおいて、契約に関して知り得た情報を取り扱ってはならない。
 - (5) 受注者は、量研機構の承諾のない限り、契約に関して知り得た情報を量研機構又は受注者の情報システム 以外の情報システム（業務担当者が所有するパソコン等）において取り扱ってはならない。
 - (6) 受注者は、委任をし、又は下請負をさせた場合は、当該委任又は下請負を受けた者の契約に関する 行為について、量研機構に対し全ての責任を負うとともに、当該委任又は下請負を受けた者に対して、 情報セキュリティの確保について必要な措置を講ずるように努めなければならない。
 - (7) 受注者は、量研機構が求めた場合には、情報セキュリティ対策の実施状況についての監査を受け入れ、 これに協力すること。
 - (8) 受注者は、量研機構の提供した情報並びに受注者及び委任又は下請負を受けた者が契約業務のために収集した情報について、災害、紛失、破壊、改ざん、き損、漏えい、コンピュータウィルスによる 被害、不正な利用、不正アクセスその他の事故が発生、又は生ずるおそれのあることを知った場合は、直ちに量研機構に報告し、量研機構の指示に従うものとする。契約の終了後においても、同様とする。

なお、量研機構の入札に参加する場合、又は量研機構からの見積依頼を受ける場合にも、上記事項を遵守していただきます。

以上

知的財産権特約条項

(知的財産権等の定義)

第1条 この特約条項において「知的財産権」とは、次の各号に掲げるものをいう。

- 一 特許法（昭和34年法律第121号）に規定する特許権、実用新案法（昭和34年法律第123号）に規定する実用新案権、意匠法（昭和34年法律第125号）に規定する意匠権、半導体集積回路の回路配置に関する法律（昭和60年法律第43号）に規定する回路配置利用権、種苗法（平成10年法律第83号）に規定する育成者権及び外国における上記各権利に相当する権利（以下総称して「産業財産権等」という。）
- 二 特許法に規定する特許を受ける権利、実用新案法に規定する実用新案登録を受ける権利、意匠法に規定する意匠登録を受ける権利、半導体集積回路の回路配置に関する法律に規定する回路配置利用権の設定の登録を受ける権利、種苗法に規定する品種登録を受ける地位及び外国における上記各権利に相当する権利
- 三 著作権法（昭和45年法律第48号）に規定する著作権（著作権法第21条から第28条までに規定する全ての権利を含む。）及び外国における著作権に相当する権利（以下総称して「著作権」という。）
- 四 前各号に掲げる権利の対象とならない技術情報のうち、秘匿することが可能なものであって、かつ、財産的価値のあるものの中から、甲乙協議の上、特に指定するもの（以下「ノウハウ」という。）を使用する権利

2 この特約条項において「発明等」とは、次の各号に掲げるものをいう。

- 一 特許権の対象となるものについてはその発明
- 二 実用新案権の対象となるものについてはその考案
- 三 意匠権、回路配置利用権及び著作権の対象となるものについてはその創作、育成者権の対象となるものについてはその育成並びにノウハウを使用する権利の対象となるものについてはその案出

3 この契約書において知的財産権の「実施」とは、特許法第2条第3項に定める行為、実用新案法第2条第3項に定める行為、意匠法第2条第2項に定める行為、半導体集積回路の回路配置に関する法律第2条第3項に定める行為、種苗法第2条第5項に定める行為、著作権法第21条から第28条までに規定する全ての権利に基づき著作物を利用する行為、種苗法第2条第5項に定める行為及びノウハウを使用する行為をいう。

(乙が単独で行った発明等の知的財産権の帰属)

第2条 甲は、本契約に関して、乙が単独で発明等行ったときは、乙が次の各号のいずれの規定も遵守することを書面にて甲に届け出た場合、当該発明等に係る知的財産権を乙から譲り受けないものとする。

- 一 乙は、本契約に係る発明等を行った場合には、次条の規定に基づいて遅滞なくその旨を甲に報告する。
- 二 乙は、甲が国の要請に基づき公共の利益のために特に必要があるとしてその理由を明らかにして求める場合には、無償で当該知的財産権を実施する権利を国に許諾する。
- 三 乙は、当該知的財産権を相当期間活用していないと認められ、かつ、当該知的財産権を相当期間活用していないことについて正当な理由が認められない場合において、甲が国の要請に基づき当該知的財産権の活用を促進するために特に必要があるとしてその理由を明らかにして求めるときは、当該知的財産権を実施する権利を第三者に許諾する。
- 四 乙は、第三者に当該知的財産権の移転又は当該知的財産権についての専用実施権（仮専用実施権を含む。）若しくは専用利用権の設定その他日本国内において排他的に実施する権利の設定若しくは移転の承諾（以下「専用実施権等の設定等」という。）をするときは、合併又は分割により移転する場合及び次のイからハまでに規定する場合を除き、あらかじめ甲に届け出、甲の承認を受けなければならない。
 - イ 子会社（会社法（平成17年法律第86号）第2条第3号に規定する子会社をいう。以下同じ。）又は親会社（会社法第2条第4号に規定する親会社をいう。以下同じ。）に当該知的財産権の移転又は専用実施権等の設定等をする場合
 - ロ 承認TLO（大学等における技術に関する研究成果の民間事業者への移転の促進に関する法律（平成10年法律第52号）第4条第1項の承認を受けた者（同法第5条第1項の変更の承認を受けた者を含む。））又は認定TLO（同法第11条第1項の認定を受けた者）に当該知的財産権の移転又は専用実施権等の設定等をする場合
 - ハ 乙が技術研究組合である場合、乙がその組合員に当該知的財産権を移転又は専用実施権等の設定等をする場合
- 2 乙は、前項に規定する書面を提出しない場合、甲から請求を受けたときは当該知的財産権を甲に譲り渡さなければならない。
- 3 乙は、第1項に規定する書面を提出したにもかかわらず、同項各号の規定のいずれかを満たしておらず、かつ、満たしていないことについて正当な理由がないと甲が認める場合において、甲から請求を受けたときは当該知的財産権を無償で甲に譲り渡さなければならない。

（知的財産権の報告）

- 第3条 前条に関して、乙は、本契約に係る産業財産権等の出願又は申請を行うときは、出願又は申請に際して提出すべき書類の写しを添えて、あらかじめ甲にその旨を通知しなければならない。
- 2 乙は、産業技術力強化法（平成12年法律第44号）第17条第1項に規定する特定研

究開発等成果に該当するもので、かつ、前項に係る国内の特許出願、実用新案登録出願、意匠登録出願を行う場合は、特許法施行規則（昭和35年通商産業省令第10号）、実用新案法施行規則（昭和35年通商産業省令第11号）及び意匠法施行規則（昭和35年通商産業省令第12号）等を参考にし、当該出願書類に国の委託事業に係る研究の成果による出願である旨を表示しなければならない。

- 3 乙は、第1項に係る産業財産権等の出願又は申請に関して設定の登録等を受けた場合には、設定の登録等の日から60日以内（ただし、外国にて設定の登録等を受けた場合は90日以内）に、甲にその旨書面により通知しなければならない。
- 4 乙は、本契約に係る産業財産権等を自ら実施したとき及び第三者にその実施を許諾したとき（ただし、第5条第4項に規定する場合を除く。）は、実施等した日から60日以内（ただし、外国にて実施等をした場合は90日以内）に、甲にその旨書面により通知しなければならない。
- 5 乙は、本契約に係る産業財産権等以外の知的財産権について、甲の求めに応じて、自己による実施及び第三者への実施許諾の状況を書面により甲に報告しなければならない。

（乙が単独で行った発明等の知的財産権の移転）

第4条 乙は、本契約に関して乙が単独で行った発明等に係る知的財産権を第三者に移転する場合（本契約の成果を刊行物として発表するために、当該刊行物を出版する者に著作権を移転する場合を除く。）には、第2条から第6条まで及び第12条の規定の適用に支障を与えないよう当該第三者に約させなければならない。

- 2 乙は、前項の移転を行う場合には、当該移転を行う前に、甲にその旨書面により通知し、あらかじめ甲の承認を受けなければならない。ただし、乙の合併又は分割により移転する場合及び第2条第1項第4号イからハまでに定める場合には、この限りでない。
- 3 乙は、第1項に規定する第三者が乙の子会社又は親会社（これらの会社が日本国外に存する場合に限る。）である場合には、同項の移転を行う前に、甲に事前連絡の上、必要に応じて甲乙間で調整を行うものとする。
- 4 乙は、第1項の移転を行ったときは、移転を行った日から60日以内（ただし、外国にて移転を行った場合は90日以内）に、甲にその旨書面により通知しなければならない。
- 5 乙が第1項の移転を行ったときは、当該知的財産権の移転を受けた者は、当該知的財産権について、第2条第1項各号及び第3項並びに第3条から第6条まで及び第12条の規定を遵守するものとする。

（乙が単独で行った発明等の知的財産権の実施許諾）

第5条 乙は、本契約に関して乙が単独で行った発明等に係る知的財産権について第三者に実施を許諾する場合には、第2条、本条及び第12条の規定の適用に支障を与えないよう当該第三者に約させなければならない。

- 2 乙は、本契約に関して乙が単独で行った発明等に係る知的財産権に関し、第三者に専用実施権等の設定等を行う場合には、当該設定等を行う前に、甲にその旨書面により通知し、あらかじめ甲の書面による承認を受けなければならない。ただし、乙の合併又は分割により移転する場合及び第2条第1項第4号イからハまでに定める場合は、この限りではない。
- 3 乙は、前項の第三者が乙の子会社又は親会社（これらの会社が日本国外に存する場合に限る。）である場合には、同項の専用実施権等の設定等を行う前に、甲に事前連絡のうえ、必要に応じて甲乙間で調整を行うものとする。
- 4 乙は、第2項の専用実施権等の設定等を行ったときは、設定等を行った日から60日以内（ただし、外国にて設定等を行った場合は90日以内）に、甲にその旨書面により通知しなければならない。
- 5 甲は、本契約に関して乙が単独で行った発明等に係る知的財産権を無償で自ら試験又は研究のために実施することができる。甲が 甲のために第三者に製作させ、又は業務を代行する第三者に再実施権を許諾する場合は、乙の承諾を得た上で許諾するものとし、その実施条件等は甲乙協議のうえ決定する。

（乙が単独で行った発明等の知的財産権の放棄）

第6条 乙は、本契約に関して乙が単独で行った発明等に係る知的財産権を放棄する場合は、当該放棄を行う前に、甲にその旨書面により通知しなければならない。

（甲及び乙が共同で行った発明等の知的財産権の帰属）

第7条 甲及び乙は、本契約に関して甲乙共同で発明等を行ったときは、当該発明等に係る知的財産権について共同出願契約を締結し、甲乙共同で出願又は申請するものとし、当該知的財産権は甲及び乙の共有とする。ただし、乙は、次の各号のいずれの規定も遵守することを書面にて甲に届け出なければならない。

- 一 乙は、甲が国の要請に基づき公共の利益のために特に必要があるとしてその理由を明らかにして求める場合には、無償で当該知的財産権を実施する権利を国に許諾する。
- 二 乙は、当該知的財産権を相当期間活用していないと認められ、かつ、当該知的財産権を相当期間活用していないことについて正当な理由が認められない場合において、甲が国の要請に基づき当該知的財産権の活用を促進するために特に必要があるとしてその理由を明らかにして求めるときは、当該知的財産権を実施する権利を甲が指定する 第三者に許諾する。
- 2 前項の場合、出願又は申請のための費用は原則として、甲、乙の持分に比例して負担するものとする。
- 3 乙は、第1項に規定する書面を提出したにもかかわらず、同項各号の規定のいずれかを満たしておらず、さらに満たしていないことについて正当な理由がないと甲が認める場合において、甲から請求を受けたときは当該知的財産権のうち乙が所有する部分が無償で甲に譲り渡さなければならない。

(甲及び乙が共同で行った発明等の知的財産権の移転)

第8条 甲及び乙は、本契約に関して甲乙共同で行った発明等に係る共有の知的財産権のうち、自らが所有する部分を相手方以外の第三者に移転する場合には、当該移転を行う前に、その旨を相手方に書面により通知し、あらかじめ相手方の書面による同意を得なければならない。

(甲及び乙が共同で行った発明等の知的財産権の実施許諾)

第9条 甲及び乙は、本契約に関して甲乙共同で行った発明等に係る共有の知的財産権について第三者に実施を許諾する場合には、その許諾の前に相手方に書面によりその旨通知し、あらかじめ相手方の書面による同意を得なければならない。

(甲及び乙が共同で行った発明等の知的財産権の実施)

第10条 甲は、本契約に関して乙と共同で行った発明等に係る共有の知的財産権を試験又は研究以外の目的に実施しないものとする。ただし、甲は甲のために第三者に製作させ、又は業務を代行する第三者に実施許諾する場合は、無償にて当該第三者に実施許諾することができるものとする。

2 乙が本契約に関して甲と共同で行った発明等に係る共有の知的財産権について自ら商業的实施をするときは、甲が自ら商業的实施をしないことに鑑み、乙の商業的实施の計画を勘案し、事前に実施料等について甲乙協議の上、別途実施契約を締結するものとする。

(甲及び乙が共同で行った発明等の知的財産権の放棄)

第11条 甲及び乙は、本契約に関して甲乙共同で行った発明等に係る共有の知的財産権を放棄する場合は、当該放棄を行う前に、その旨を相手方に書面により通知し、あらかじめ相手方の書面による同意を得なければならない。

(著作権の帰属)

第12条 第2条第1項及び第7条第1項の規定にかかわらず、本契約の目的として作成され納入される著作物に係る著作権については、全て甲に帰属する。

2 乙は、前項に基づく甲及び甲が指定する 第三者による実施について、著作者人格権を行使しないものとする。また、乙は、当該著作物の著作者が乙以外の者であるときは、当該著作者が著作者人格権を行使しないように必要な措置を執るものとする。

3 乙は、本契約によって生じた著作物及びその二次的著作物の公表に際し、本契約による成果である旨を明示するものとする。

(合併等又は買収の場合の報告等)

第13条 乙は、合併若しくは分割し、又は第三者の子会社となった場合(乙の親会社に変更した場合を含む。第3項第1号において同じ。)は、甲に対しその旨速やかに報告し

なければならない。

2 前項の場合において、国の要請に基づき、国民経済の健全な発展に資する観点に照らし、本契約の成果が事業活動において効率的に活用されないおそれがあると甲が判断したときは、乙は、本契約に係る知的財産権を実施する権利を甲が指定する者に許諾しなければならない。

3 乙は、本契約に係る知的財産権を第三者に移転する場合、次の各号のいずれの規定も遵守することを当該移転先に約させなければならない。

一 合併若しくは分割し、又は第三者の子会社となった場合は、甲に対しその旨速やかに報告する。

二 前号の場合において、国の要請に基づき、国民経済の健全な発展に資する観点に照らし本業務の成果が事業活動において効率的に活用されないおそれがあると甲が判断したときは、本契約に係る知的財産権を実施する権利を甲が指定する者に許諾する。

三 移転を受けた知的財産権をさらに第三者に移転するときは、本項各号のいずれの規定も遵守することを当該移転先に約させる。

（秘密の保持）

第14条 甲及び乙は、第2条及び第7条の発明等の内容を出願公開等により内容が公開される日まで他に漏えいしてはならない。ただし、あらかじめ書面により出願又は申請を行った者の了解を得た場合はこの限りではない。

（委任・下請負）

第15条 乙は、本契約の全部又は一部を第三者に委任し、又は請け負わせた場合においては、当該第三者に対して、本特約条項の各規定を準用するものとし、乙はこのために必要な措置を講じなければならない。

2 乙は、前項の当該第三者が本特約条項に定める事項に違反した場合には、甲に対し全ての責任を負うものとする。

（協議）

第16条 第2条及び第7条の場合において、単独若しくは共同の区別又は共同の範囲等について疑義が生じたときは、甲乙協議して定めるものとする。

（有効期間）

第17条 本特約条項の有効期限は、本契約の締結の日から当該知的財産権の消滅する日までとする。

以上

イーター実施協定の調達に係る情報及び知的財産に関する特約条項

本契約については、本契約一般条項によるほか、次の特約条項（以下「本特約条項」という。）による。

（定義）

第1条 本契約において「知的財産権」とは、次の各号に掲げるものをいう。

- （1） 特許法（昭和34年法律第121号）に規定する特許権又は特許を受ける権利
- （2） 実用新案法（昭和34年法律第123号）に規定する実用新案権又は実用新案登録を受ける権利
- （3） 意匠法（昭和34年法律第125号）に規定する意匠権又は意匠登録を受ける権利
- （4） 商標法（昭和34年法律第127号）に規定する商標権又は商標登録を受ける権利
- （5） 半導体集積回路の回路配置に関する法律（昭和60年法律第43号）に規定する回路配置利用権又は回路配置利用権の設定の登録を受ける権利
- （6） 種苗法（平成10年法律第83号）に規定する育成者権又は品種登録を受ける地位
- （7） 著作権法（昭和45年法律第48号）に規定するプログラムの著作物及びデータベースの著作物の著作権
- （8） 外国における、第1号から第7号に記載の各知的財産権に相当する権利
- （9） 不正競争防止法（平成5年法律第47号）に規定する営業秘密に関して法令により定められた権利又は法律上保護される利益に係る権利（以下「営業秘密」という。）

2 本契約において「情報」とは、法律による保護を受けることができるか否かを問わず、発明や発見の記述のみならず、公表されている資料、図書、意匠、計算書、報告書その他の文書、研究開発に関する記録された資料又は方法並びに発明及び発見に関する説明であって、前項に定義する知的財産権を除いたものをいう。

3 本契約において「発明等」とは、特許権の対象となるものについては発明、実用新案権の対象となるものについては考案、意匠権、商標権、回路配置利用権及びプログラム等の著作権の対象となるものについては創作、育成者権の対象となるものについては育成並びに営業秘密を使用する権利の対象となるものについては案出をいう。

4 本契約において「背景的な知的財産権」とは、本契約の締結前に取得され、開発され、若しくは創出された知的財産権又は本契約の範囲外において取得され、開発され、若しくは創出される知的財産権をいう。

5 本契約において「背景的な営業秘密」とは、背景的な知的財産権のうちの営業秘密をいう。

6 本契約において「生み出された知的財産権」とは、本契約の履行の過程で、乙が単独で又は甲と共同で取得し、開発し、又は創出した知的財産権をいう。

7 本契約において「協定」とは、「イーター事業の共同による実施のためのイーター国際核融合エネルギー機構の設立に関する協定」をいう。

8 本契約において「附属書」とは、協定の「情報及び知的財産に関する附属書」をいう。

9 本契約において「イーター機構」とは、協定により設立された「イーター国際核融合エネルギー機構」をいう。

10 本契約において「加盟者」とは、協定の締約者をいう。

11 本契約において「国内機関」とは、各加盟者がイーター機構への貢献を行うに当たって、

その実施機関として指定する法人をいう。

1 2 本契約において「団体」とは、国内機関又はイーター機構が協定の目的のために物品又は役務の提供に関する契約を締結する団体をいう。

1 3 本契約において「理事会」とは、協定第6条に定める「理事会」をいう。

1 4 本契約において「特許等」とは、特許、登録実用新案、登録意匠、登録商標、登録回路配置及び登録品種の総称をいう。

(情報の普及)

第2条 乙は、加盟者又は国内機関が、本契約の実施により直接に生じる情報（著作権の有無を問わない。）を非商業上の利用のため翻訳し、複製し、及び公に頒布する権利を有することに同意する。

2 乙は、前項により作成される著作権のある著作物の写しであって公に頒布されるすべてのものには、著作者が明示的に記名を拒否しない限り、著作者の氏名を明示することに同意する。

(発明等の報告)

第3条 乙は、本契約の履行の過程で発明等を創出した場合には（以下、かかる発明等を「本発明等」という。）、本発明の詳細とともに、速やかに甲に書面により報告するものとする。

2 乙は、甲が前項の本発明の詳細を含む報告をイーター機構及び加盟者に提供すること、並びに、甲が自ら実施する核融合の研究開発に関する活動のため必要とする場合において乙以外の日本の団体に提供することに、あらかじめ同意する。

(生み出された知的財産権の帰属等)

第4条 本発明等に係る知的財産権は、乙に帰属する。ただし、本発明等が甲乙共同で創出したものである場合、当該本発明等に係る知的財産権は甲及び乙の共有となる。

2 前項ただし書きの甲及び乙の共有に係る知的財産権について、甲及び乙は、知的財産権の持分、費用分担、その他必要な事項を協議の上、別途取決めを締結するものとする。

3 乙は、甲及び乙の共有に係る当該知的財産権を自ら又は乙が指定する者が実施する場合、甲及び乙の持分に応じてあらかじめ定める不実施補償料を甲に支払うものとする。

(発明等の取扱い)

第5条 乙は、本発明等に関し、(i)特許等の登録に必要な手続を行うか、(ii)営業秘密として管理するか、又は、(iii)(i)若しくは(ii)のいずれも行わないかという取扱いについて速やかに決定の上、甲に決定内容を書面により報告する。ただし、当該本発明等が甲乙共同で創出したものである場合、甲及び乙は、上記(i)ないし(iii)の取扱いについて別途協議の上決定する。

2 乙は、前項に基づく本発明等の取扱いに関する決定内容について、甲がイーター機構及び加盟者に提供すること、並びに甲が自ら実施する核融合の研究開発に関する活動のため必要とする場合において乙以外の日本の団体に提供することに、あらかじめ同意する。

3 乙は、乙が第1項の(iii)の取扱いをすることを決定した本発明等について、甲又はイーター機構の求めがあった場合は、当該本発明等の知的財産権を甲又はイーター機構に承継させるものとする。

（背景的な知的財産権の認定）

第6条 乙が本契約の履行の過程で利用する背景的な知的財産権は、甲及び乙が別途締結する覚書（以下「覚書」という。）に定める。覚書に定めのない知的財産権であって、本契約の履行の過程で利用されるものは、生み出された知的財産権とみなす。

2 乙は、覚書に掲げる知的財産権の内容に変更が生じたときは、速やかに当該変更内容を甲に書面により報告するものとする。

3 乙は、本契約締結後に本契約の履行の過程で利用すべき背景的な知的財産権の存在が判明したときは、速やかに、当該背景的な知的財産権が、本契約の範囲外において存在することを証明する具体的な証拠とともに、本契約締結前に報告できなかった正当な理由を甲に書面により報告するものとする。

4 甲は、前項の報告を受けた場合は、乙から提出された証拠及び理由の妥当性を検討の上、必要に応じて、甲乙協議の上、覚書の改訂を行うものとする。

5 乙は、本条に基づく報告について、甲がイーター機構及び加盟者に提供すること、並びに甲が自ら実施する核融合の研究開発に関する活動のため必要とする場合において乙以外の日本の団体に提供することに、あらかじめ同意する。

6 乙は、本契約の履行の過程で背景的な知的財産権を利用する場合は、必要な実施権又は利用権を確保し、甲並びに契約物品の提供を受けるイーター機構及び関連する他の加盟者が、支障なく当該物品を使用することができるようにしなければならない。甲並びにイーター機構及び関連する他の加盟者が当該背景的な知的財産権に関し、第三者から知的財産権侵害の苦情を受けた場合には、乙は自己の責任と費用でその苦情を防御又は解決し、当該苦情に起因する損失、損害又は経費のすべてを補償し、甲並びにイーター機構及び関連する他の加盟者に対して何らの損害も与えないものとする。

（背景的な知的財産権の帰属）

第7条 本契約は、背景的な知的財産権の帰属について何ら変更を生じさせるものではない。

（創出者への補償等）

第8条 乙は、乙の従業者又は役員（以下「従業者等」という。）が創出した本発明等に係る知的財産権を、適用法令に従い、乙の費用と責任において従業者等から承継するものとする。

（生み出された知的財産権の実施）

第9条 生み出された知的財産権の実施権の許諾（利用権の付与を含む。以下同じ。）については、次の各号による。

（1） 乙は、甲が自ら実施する研究開発に関する活動のために、平等及び無差別の原則に基づき、当該生み出された知的財産権の取消し不能な、非排他的な、かつ、無償の実施権を甲に許諾する。当該実施権は、甲が第三者に再実施を許諾する権利を伴う。

（2） 乙は、公的な支援を得た核融合の研究開発に関する計画のため、平等及び無差別の原則に基づき、当該生み出された知的財産権の取消し不能な、非排他的な、かつ、無償の実施権を加盟者及びイーター機構に許諾する。当該実施権は、イーター機構及び加盟者が第三

者（加盟者については、それぞれの領域内の第三者に限る。）に再実施を許諾する権利を伴う。

（３） 乙は、核融合の商業上の利用のため、平等及び無差別の原則に基づき、生み出された知的財産権の非排他的な実施権を加盟者に許諾する。当該実施権は、加盟者が第三者（それぞれの領域内の第三者に限る。）に再実施を許諾する権利を伴う。当該実施権の許諾に係る条件は、乙が第三者に対して当該生み出された知的財産権の実施権を許諾するときの条件よりも不利でないものとする。

（４） 乙は、生み出された知的財産権の核融合以外の分野における利用を可能にするため、加盟者、国内機関、団体及び第三者と商業上の取決めを締結することが奨励される。

２ 前項の生み出された知的財産権が甲と乙の共有に係るものである場合、甲と乙は、共同して同項に基づく実施権の許諾を行う。

３ 乙は、第１項に規定する実施権及び再実施を許諾する権利の許諾の記録を保持し、甲の求めに応じこれを甲に提供する。乙は、上記記録に変更がある場合は、各年の上半期については、７月１５日までに、下半期については翌年の１月１５日までに甲に報告書を提出する。

４ 乙は、甲が当該記録をイーター機構及び加盟者に提供すること、並びに甲が自ら実施する核融合の研究開発に関する活動のため必要とする場合において乙以外の日本の団体に提供することに、あらかじめ同意する。

５ 乙は、非加盟者の第三者に対し、生み出された知的財産権の実施権を許諾する場合には、理事会が全会一致で決定する規則に従うものとし、甲の事前の同意を得て行うものとする。当該第三者への実施権の許諾は、平和的目的のための使用に限り行うものとする。ただし、当該規則の決定までは、非加盟者の第三者に対する当該実施権の許諾は認めない。

６ 乙は、イーター機構又は加盟者に対して直接実施許諾できない理由があるときには、甲が第１項第２号及び第３号に基づきイーター機構又は加盟者に再実施を許諾するための権利を伴う、生み出された知的財産権の取消し不能な、非排他的な、かつ、無償の実施権を甲に許諾するものとする。

（背景的な知的財産権の実施）

第１０条 乙が契約物品その他仕様書に定める納入品に用いる背景的な知的財産権の実施権の許諾については、次の各号による。

（１） 乙は、当該背景的な知的財産権（ただし、背景的な営業秘密を含まない。）が次のいずれかの要件を満たすときは、甲が自ら実施する核融合の研究開発に関する活動のために、平等及び無差別の原則に基づき、当該背景的な知的財産権の取消し不能な、非排他的な、かつ、無償の実施権を甲に許諾する。当該実施権は、甲が研究機関及び高等教育機関に再実施を許諾する権利を伴う。

イ イーター施設を建設し、運転し、及び利用するために必要とされること又はイーター施設に関連する研究開発のための技術を用いるために必要とされること。

ロ イーター機構に提供される契約物品を保守し、又は修理するために必要とされること。

ハ 公的な調達に先立ち理事会が必要であると決定する場合において必要とされること。

（２） 乙は、当該背景的な知的財産権（ただし、背景的な営業秘密を含まない。）が次のいず

れかの要件を満たすときは、公的な支援を得た核融合の研究開発に関する計画のため、平等及び無差別の原則に基づき、当該背景的な知的財産権の取消し不能な、非排他的な、かつ、無償の実施権を加盟者及びイーター機構に許諾する。当該実施権は、イーター機構が再実施を許諾する権利並びに加盟者がそれぞれの領域内において研究機関及び高等教育機関に再実施を許諾する権利を伴う。

イ イーター施設を建設し、運転し、及び利用するために必要とされること又はイーター施設に関連する研究開発のための技術を用いるために必要とされること。

ロ イーター機構に提供される契約物品を保守し、又は修理するために必要とされること。

ハ 公的な調達に先立ち理事会が必要であると決定する場合において必要とされること。

- (3) 乙は、当該背景的な営業秘密が次のいずれかの要件を満たすときは、当該背景的な営業秘密（イーター施設の建設、運転、保守及び修理のための手引書又は訓練用教材を含む。）の取消し不能な、非排他的な、かつ、無償の利用権をイーター機構に付与する。当該利用権は、イーター機構が、協定の情報及び知的財産に関する附属書第4、2、3条（b）に基づき、その下請負人に再利用権を付与する権利及びフランス規制当局に当該背景的な営業秘密を伝達する権利を伴う。

イ イーター施設を建設し、運転し、及び利用するために必要とされること又はイーター施設に関連する研究開発のための技術を用いるために必要とされること。

ロ イーター機構に提供される契約物品を保守し、又は修理するために必要とされること。

ハ 公的な調達に先立ち理事会が必要であると決定する場合において必要とされること。

ニ イーター施設に対して規制当局が要請する安全、品質保証及び品質管理のために必要とされること。

- (4) 乙は、当該背景的な営業秘密が次のいずれかの要件を満たすときは、加盟者が公的な支援を得た核融合の研究開発に関する計画のため、金銭上の補償を伴う私的契約によって、当該背景的な営業秘密の商業上の利用権の付与又は当該背景的な営業秘密を用いた契約物品と同一の物品の提供を求めた場合には、当該契約締結のため最善の努力を払うこととする。当該利用権の付与又は物品の提供に係る条件は、乙が第三者に対して当該背景的な営業秘密の利用権を付与し、又は当該背景的な営業秘密を用いた同一の物品を提供するときの条件よりも不利でないものとする。当該利用権が付与される場合には、当該利用権は、利用権者が契約上の義務を履行しない場合にのみ取り消すことができる。

イ イーター施設を建設し、運転し、及び利用するために必要とされること又はイーター施設に関連する研究開発のための技術を用いるために必要とされること。

ロ イーター機構に提供される契約物品を保守し、又は修理するために必要とされること。

ハ 公的な調達に先立ち理事会が必要であると決定する場合において必要とされること。

- (5) 乙は、当該背景的な知的財産権について、加盟者が核融合の商業上の利用のため、当該背景的な知的財産権の実施権の許諾を受けること又は当該背景的な知的財産権を用いた契約物品と同一の物品の提供を求めた場合には、当該要求の実現のため最善の努力を払うこととする。当該背景的な知的財産権の実施権は、当該加盟者の領域内にある第三者による核融合の商業上の利用のために当該加盟者が再実施を許諾する権利を伴う。当該背景的な知的財産権の実施権の許諾に係る条件は、乙が第三者に対して当該背景的な知的財産権の実施権を

許諾するときの条件よりも不利でないものとする。当該背景的な知的財産権の実施権は、実施権者が契約上の義務を履行しない場合にのみ取り消すことができる。

- (6) 乙は、前号に定める目的以外の商業上の目的のため、加盟者から求めがあった場合は、当該背景的な知的財産権が次のいずれかの要件を満たすときは、当該背景的な知的財産権の実施権を許諾することが奨励される。乙が、当該背景的な知的財産権の実施権を当該加盟者に許諾する場合には、当該背景的な知的財産権の実施権は平等及び無差別の原則に基づき許諾されるものとする。

イ イーター施設を建設し、運転し、及び利用するために必要とされること又はイーター施設に関連する研究開発のための技術を用いるために必要とされること。

ロ イーター機構の提供される契約物品を保守し、又は修理するために必要とされること。

ハ 公的な調達に先立ち理事会が必要であると決定する場合において必要とされること。

- 2 前項の背景的な知的財産権が甲と乙の共有に係るものである場合、甲と乙は、共同して当該背景的な知的財産権の実施権の許諾を行う。
- 3 乙は、第1項に規定する実施権及び再実施を許諾する権利の許諾の記録を保持し、甲の求めに応じこれを甲に提供する。乙は、上記記録に変更がある場合は、各年の上半期については7月15日までに、下半期については翌年の1月15日までに甲に報告書を提出する。
- 4 乙は、甲が当該記録をイーター機構及び加盟者に提供すること、並びに甲が自ら実施する核融合の研究開発に関する活動のため必要とする場合において乙以外の日本の団体に提供することに、あらかじめ同意する。

(知的財産権の帰属の例外)

第11条 乙は、本契約の目的として作成される提出書類、プログラム及びデータベース等の納入品に係る著作権は、すべて甲に帰属することを認め、乙が著作権を有する場合（第8条に基づき従業者等から承継する場合を含む。）であっても、乙は、かかる著作権（著作権法第21条から第28条までに定める全ての権利を含み、日本国内における権利に限らない。）を甲に譲渡する。かかる譲渡の対価は、本契約書に定める請負の対価に含まれる。

- 2 前項の規定により著作権を乙から甲に譲渡する場合において、当該著作物を乙が自ら創作したときは、乙は、著作者人格権を行使しないものとし、当該著作物を乙以外の第三者が創作したときは、乙は、当該第三者に著作者人格権を行使しないように必要な措置を講じるものとする。

(下請負人に対する責任)

第12条 乙は、本契約一般条項の規定に従い、下請負人に対し本契約の一部を履行させる場合、本特約条項に基づく乙の一切の義務を乙の責任において当該下請負人に遵守させるものとする。

(有効期間)

第13条 本契約一般条項の定めにかかわらず、本特約条項の定めは協定の終了後又は日本国政府の協定からの脱退後も効力を有する。

(言語)

第14条 本特約条項に定める乙から甲への書面による報告は、和文だけでなく、英文でも提出することとし、両文書は等しく正文とする。

(疑義)

第15条 本特約条項の解釈又は適用に関して疑義が生じた場合、協定の規定が本特約条項に優先する。

イーター調達に係る貨物の免税輸入について

イーター事業の共同による実施のためのイーター国際核融合エネルギー機構の特権及び免除に関する協定（イーター協定）に基づき、イーターに係る貨物の日本国内機関(JADA)及びメーカー・商社による輸入関税及び引取りに係る内国消費税の免税輸入を可能とする例外的な措置について、以下の要件等を遵守することで免税法令の適用対象となることが出来ます。

1. 免税適用のための要件

(1) 免税適用となる貨物

- ・イーター活動（R&D 及びクオリフィケーションを含む）のためだけに使用される物品を適用対象とする。
- ・この内、完成品（本契約における納入品を言う）のみを適用対象とする。
- ・ただし、8割方以上完成している物品については、ほぼ完成品の輸入とみなし、適用対象とする。

(2) 免税適用とならない貨物

- ・原材料及び資機材、並びに製作治具等。
- ・本契約締結日より前に輸入した物品。
- ・上記(1)に該当する物品と該当しない物品とが混在して輸入され、別個に通関申告が出来ない場合。

疑義が生じる場合には、輸入前にQST担当者と別途協議するものとする。

2. 必要な手続き

- (1) 1. (1)に該当する貨物を輸入する際には、輸入手続きを開始する前に必ずQSTの契約担当者に申し出ること。免税適用に疑義がある場合も同様とする。
- (2) 受注者は、輸入申告前に原子力機構から発行される「確認書」の正本を受領し、輸入通関書類と併せて申告すること。

3. 契約に係る注意事項

- ・免税輸入通関のためには、通関申告前に、QSTから通関を予定している税関に連絡する必要がある。（その際、輸入通関書類及び「確認書」（写し）の提出をしている）。
- ・契約に際しては、免税を加味しない金額で契約を実施するが、免税が適用された場合には、免税相当額を減額して支払うこととし、事前に書面をもって確認する。

- ・ 免税適用可否については、通関する担当税関が最終判断を担うが、(1)にて免税適用となりうる貨物に関しては、免税となるよう誠意をもってQST担当者と協力すること。

2. 免税適用法令一抜粋（参考）

(1) 関税定率法（外交官用貨物等の免税）

第十六条 左の各号に掲げる貨物で輸入されるものについては、政令で定めるところにより、その関税を免除する。

- 一 本邦にある外国の大使館、公使館その他これらに準ずる機関に属する公用品。但し、外国にある本邦のこれらの機関に属する公用品についての関税の免除に制限を附する国については、相互条件による。

(2) 輸入品に対する内国消費税の徴収等に関する法律（免税等）

第十三条 次の各号に掲げる課税物品で当該各号に規定する規定により関税が免除されるもの（関税が無税とされている物品については、当該物品に関税が課されるものとした場合にその関税が免除されるべきものを含む。第三項において同じ。）を保税地域から引き取る場合には、政令で定めるところにより、その引取りに係る消費税を免除する。

- 三 関税定率法第十六条第一項 各号（外交官用貨物等の免税）に掲げるもの

以上

コンピュータプログラム作成等業務特約条項

(目的物)

第1条 この契約の目的物は、次の各号の一又は二以上の組み合わせに該当するコンピュータプログラムの著作物（データ、データベース、マニュアル及びドキュメンテーションを含む。以下同じ。）及び当該コンピュータプログラムによる計算結果であって、仕様書に定める範囲のものとする。

- 一 コンピュータプログラム（コンピュータプログラムの設計を含む。）著作物
- 二 甲が提供するコンピュータプログラムの著作物により得られた計算結果
- 三 乙が所有するコンピュータプログラムの著作物及びこれにより得られた計算結果

(権利の帰属等)

第2条 この契約により作成された目的物（第1条各号に掲げるものをいう。以下同じ。）に係る著作権その他この目的物の使用、収益及び処分（複製、翻訳、翻案、変更、譲渡・貸与及び二次的著作物の利用を含む。）に関する一切の権利は甲に帰属するものとする。ただし、本契約遂行のために使用するプログラム等のうち、本契約締結以前から、乙が所有するものについては、その著作権は乙に帰属するものとする。

2 乙は、この契約により作成された目的物について、甲又は甲の指定する者に対して著作者人格権を行使しないものとする。

(氏名の表示の制限)

第3条 乙は、第1条に規定する著作物に著作者氏名を表示しないものとする。

(第三者の権利の保護)

第4条 乙は、この業務の実施に関し第三者（著作者を含む。）の著作権その他の権利を侵害することのないよう必要な措置を自らの責任において講じなければならない。

(技術情報)

第5条 甲が、この業務の実施に関し、乙の保有する技術情報を知る必要が生じた場合には、乙は、この契約の業務に必要な範囲内において当該技術情報を甲に無償で提供しなければならない。

2 甲は、乙からの書面による事前の同意を得た場合を除き、前項により知り得た技術情報を第三者に提供しないものとする。

(プログラム開発に必要な技術情報)

第6条 甲は、仕様書に定めるところにより、乙がこの業務の実施に必要な計算コードその他必要な技術情報を乙に使用させることがある。

(公表)

第7条 乙は、目的物を甲に引き渡す前に、これを第三者に公表してはならない。

2 乙は、この契約により得られた成果について発表し、若しくは公開し、又は第三者に提供しようとするとき、及びこの業務の実施によって知り得た技術情報を第三者に開示しようとするときは、あらかじめ書面による甲の承認を得なければならない。

以上

MQP Quality Plan

QP Template for suppliers and subcontractors

This template is for suppliers and their subcontractors to produce a Quality Plan. This is recommended template for users, not mandatory.

Approval Process			
	<i>Name</i>	<i>Action</i>	<i>Affiliation</i>
<i>Author</i>	Park S.	19-Mar-2010:signed	IO/DG/SQS/QA
<i>CoAuthor</i>			
<i>Reviewers</i>			
<i>Approver</i>	Sands D.	19-Mar-2010:approved	IO/DG/SQS/QA
Document Security: level 1 (IO unclassified)			
RO: Sands David			
<i>Read Access</i>	AD: ITER, AD: External Collaborators, AD: Division - Quality Assurance, AD: ITER Management Assessor, project administrator, RO		

<i>Change Log</i>				
<i>Title (Uid)</i>	<i>Version</i>	<i>Latest Status</i>	<i>Issue Date</i>	<i>Description of Change</i>
QP Template for suppliers and subcontractors (2MLX45_v1_1)	v1.1	Approved	19 Mar 2010	At the section 7, wordings are changed from (proposed) suppliers or subcontractors to (proposed) suppliers and subcontractors specifying what work they will be performing.
QP Template for suppliers and subcontractors (2MLX45_v1_0)	v1.0	Signed	12 Feb 2010	



Template for Suppliers and subcontractors of a DA

QUALITY PLAN

Document Number:		Revision Number:	
ITER PP Number:		ITER PA Number:	
Title of Item:			
Name of DA:			
Supplier of the DA:			
Prepared by Supplier	Approved by Supplier	Approved by DA	ITER Acceptance
Position: Name & signature	Position: Name & signature	Position: Name & signature	Position: Name & Signature
Date:	Date:	Date:	Date:

<PP: Procurement Package, PA: Procurement Arrangement>

※ This is a recommended template for user's guiding to develop a Quality Plan.

1. Scope

[This section shall describe the scope of work to be covered by this Quality Plan]

2. Quality Management

2.1 Description of Quality Management System of the organization:

[Provide certifications of recognized Quality Standards and valid date of the certifications, if any]

2.2 Detailed the breakdown of responsibilities within the organization:

[Add the organization flow chart]

2.3 Identify the different (external) organizations involved:

[Add the relationship flow chart between different organizations]

2.4 Identify within the different organizations involved the key individuals responsible for:

*[Ensuring that the activities performed in connection with the particular contract are planned, implemented and controlled and their progress monitored,
Communicating requirements peculiar to the contract to all affected organizations,
Resolving problems that may arise at interfaces between the organisations involved]*

2.5 Identify any access restrictions of IO to the premise of the supplier or its subcontractors that may apply:

3. Contract Review

[Indicate how, when and by whom contract requirements are to be reviewed and the review recorded]

4. Documents

[Show how, when and by whom documents will be controlled, and what kinds of documents will be submitted to IO]

5. Design

*[Indicate, if an organization performs design activities for the contract;
how, when and by whom design will be controlled, including:*

- *when, how, and by whom the design process is to be carried out, controlled and documented,*
- *the arrangements for the review, verification and validation of design output conformity to design inputs requirements.*

Where applicable, indicate the extent to which the IO will be involved in design activities, such as participation in design reviews and design verification.

Reference applicable codes, standards and regulatory requirements.

A list the computer programs to be used and indicate how, when, and by whom they will be controlled.

Otherwise “not applicable”.]

6. Procurement

[Show how, when and by whom procurements will be controlled.

Any important Items or activities that are to be purchased or subcontracted.

(Proposed) suppliers or subcontractors specifying what work they will be performing.

Relevant Quality Assurance Requirements and the methods to be used to satisfy regulatory requirements, which apply to, purchased or subcontracted products.]

7. Identification and control of items

[Where traceability is a requirement or necessary for the adequate control of the work, define its scope and extent, including;

How affected items are to be identified?

How contractual and regulatory traceability requirements are identified and incorporated into working documents?

What records relating to such traceability are to be generated and how and by whom they are to be controlled?]

8. Manufacture

[Indicate how processes, manufacture, assembly, inspections and tests will be controlled.

Where appropriate, introduce or refer to:

Relevant documented procedures and work instructions.

The methods to be used to monitor and control processes.

Criteria for workmanship.

Use of special and qualified processes and associated personnel.

Tools, techniques and methods to be used.]

9. Inspection and testing

[Show how, when and by whom inspection and test would be controlled, including:.

Any inspection and test plan to be used, and how and by whom they are reviewed and approved.

How and by whom inspection and test reports are reviewed and approved?

Acceptance criteria to be applied.

Acceptance of purchased or subcontracted items.

Any specific requirements for the identification of inspections and tests status.

The extent to which the IO and (Agreed) Notified Bodies will be involved, such as witnessing inspection and test.]

10. Measuring and Test Equipment

[Indicate the control system to be used for measuring and test equipment specifically used in connection with the contract, including:

- Identification of such equipment,*
- Method of calibration,*
- Method of indicating and recording calibration status.]*

11. Handling, Storage, Packing, Shipping and Delivery

[Show how, when and by whom handling, storage, packing, shipping and delivery will be controlled:

- how contract requirements for handling, storage, packaging and shipping are to be met,*
- how the item will be delivered to the specified site in a manner that will ensure that its required characteristics are not degraded.]*

12. Records

[This section should indicate:

How records are to be controlled, including how legibility, storage and retrievability will be satisfied

What records are to be kept

What records are to be supplied to the IO, when and by what means

How and by whom the records are reviewed and approved prior to inclusion in the deliverables handed over to the IO

What form the records will take (such as paper, microfilm, tape, disc or other medium) and in what language the records will be provided.]

13. Deviation and Non-Conformities

[Indicate how, when and by whom deviations and non-conformities will be processed including those originating from suppliers and subcontractor.]

14. Training and Qualification

[Address any specific training requirement for personnel and how such training is accomplished and recorded.]

15. Statistical Techniques

[Where statistical techniques are relevant for establishing, controlling and verifying process capability and item characteristics, they should be indicated.]

16. Assessment

[Indicate how, when and by whom the implementation and effectiveness of the Quality Plan will be monitored.]

17. Reference and Others (If any)

[A list of documents referenced in this Quality Plan]

❖ **Italics in boxes are provided to give instructions and need to be deleted when completing the form with an actual information.**

[Note] Preparation, implementation and approval of a Quality Plan

1. Much of the generic documentation needed to prepare a Quality Plan will normally already exist as part of the performer's quality management documents and supporting procedures. The Quality Plan need only refer to this documentation and show how it is to be applied to the work contracted.
2. DAs shall prepare a Quality Plan and submit it to the IO for approval.
3. The DA Suppliers/Subcontractors Quality Plans are approved by the DA, and then submitted to the IO for acceptance.
4. Work shall not start until the relevant Quality Plan has been accepted by the IO.
5. Work shall be performed as directed in the Quality Plan. The performers (DAs, and their suppliers and subcontractors) shall monitor the implementation and effectiveness of the Quality Plan.
6. Documents referred to in the Quality Plan should be made available to the IO.

Technical Specifications (In-Cash Procurement)

Quality Requirements for IO Performers

The purpose of this document is to provide IO performers with quality management requirements based on the quality class of structures, systems, and components (SSC).

Table of Contents

1	PURPOSE	3
2	DEFINITIONS AND ACRONYMS	3
3	REFERENCES	4
4	REQUIREMENT TO DEFINE QUALITY CLASS (QC)	5
5	COMMON REQUIREMENTS FOR QC 1-4.....	5
5.1	QUALITY MANAGEMENT SYSTEM	5
5.2	COUNTERFEIT, FRAUDULENT OR SUSPECT ITEMS (CFSI).....	5
5.3	COMMERCIAL-OFF-THE-SHELF / COTS ITEMS	6
5.4	PROPAGATION OF REQUIREMENTS	6
6	COMMON REQUIREMENTS FOR QC 1-3.....	6
6.1	CONTRACT MANAGEMENT (COMMON QC 1-3)	6
6.1.1	<i>Responsible Officer</i>	6
6.1.2	<i>Quality plan (QP)</i>	6
6.1.3	<i>Management of nonconformities</i>	7
6.1.4	<i>Management of deviations</i>	7
6.1.5	<i>Risk management</i>	7
6.1.6	<i>Access to Performer's premises</i>	7
6.2	ENGINEERING (COMMON QC 1-3)	7
6.3	MANUFACTURING, ASSEMBLY AND INSTALLATION (COMMON QC 1-3).....	7
6.3.1	<i>Inspection and Test Plan (ITP)</i>	7
6.3.2	<i>Readiness Review (CRR)</i>	7
6.3.3	<i>Material certificates</i>	7
6.3.4	<i>Manufacturing</i>	7
6.4	IO ACCEPTANCE (COMMON QC 1-3).....	7
6.4.1	<i>Contractor release note (CRN)</i>	7
6.4.2	<i>Mechanical Completion Dossier (MCD)</i>	8
6.5	STORAGE AND SHIPPING (COMMON QC 1-3)	8
6.5.1	<i>Conditions to ship - CRN and shipping notification</i>	8
6.5.2	<i>Conditions to ship - Delivery Readiness Review (DRR)</i>	8
6.5.3	<i>Shipping</i>	8
7	SPECIFIC REQUIREMENTS FOR QC 1.....	8
7.1	ENGINEERING (EXTRAS FOR QC 1)	8
7.2	MANUFACTURING, ASSEMBLY AND INSTALLATION (EXTRAS FOR QC 1)	8
7.2.1	<i>Special processes</i>	8
7.2.2	<i>Preparation and change of inspection plan (IP, MIP/ITP)</i>	8
7.2.3	<i>Readiness review (CRR, MRR)</i>	9

7.2.4	<i>Execution of IP (MIP/ITP)</i>	9
7.2.5	<i>Manufacturing dossier</i>	9
7.3	STORAGE AND SHIPPING (EXTRAS FOR QC 1)	10
7.3.1	<i>Storage</i>	10
8	SPECIFIC REQUIREMENTS FOR PE/NPE	11
8.1	QUALIFICATION OF PERSONNEL (PE/NPE).....	11
8.2	ENGINEERING (EXTRAS FOR PE/NPE).....	11
8.3	MANUFACTURING (EXTRAS FOR PE/NPE)	11
8.3.1	<i>Special processes</i>	11
8.3.2	<i>Inspection plan</i>	11
8.4	STORAGE AND SHIPPING (EXTRAS FOR PE/NPE)	11
9	ANNEX 1. REQUIREMENTS AND GUIDANCE FOR THE CONTENT AND STRUCTURE OF QUALITY PLANS (QP)	12
9.1	CONTENT	12
9.2	STRUCTURE.....	12
9.2.1	<i>Quality Management</i>	12
9.2.2	<i>Contract Review</i>	13
9.2.3	<i>Document</i>	13
9.2.4	<i>Design</i>	13
9.2.5	<i>Procurement</i>	13
9.2.6	<i>Identification and Control of items</i>	13
9.2.7	<i>Manufacture</i>	14
9.2.8	<i>Inspection and Test</i>	14
9.2.9	<i>Measuring and Test equipment</i>	14
9.2.10	<i>Handling, Storage, Packing, Shipping and Delivery</i>	14
9.2.11	<i>Records</i>	14
9.2.12	<i>Deviations and Nonconformities</i>	15
9.2.13	<i>Training and Qualification</i>	15
9.2.14	<i>Statistical Techniques</i>	15
9.2.15	<i>Assessment</i>	15
10	ANNEX 2. REQUIREMENTS AND GUIDANCE FOR THE CONTENT OF INSPECTION PLANS (IP)	16
11	ANNEX 3. REQUIREMENTS AND GUIDANCE FOR THE CONTENT OF CONTRACTOR RELEASE NOTES (CRN)	17

1 Purpose

The purpose of this document is to provide IO performers with quality management requirements based on the quality class of structures, systems, and components (SSC).

2 Definitions and acronyms

Term	Acronym	Definition
(Agreed) Notified Body	(A)NB	Notified Body agreed by the French Nuclear Authority (ASN) to perform conformity assessment of Nuclear Pressure Equipment
Acceptance		Acknowledgement that a product or document is in compliance with the Contract requirements
Approval		Formal agreement for the use or application of a product or document. The approver takes responsibility for the use.
Certificate of Conformity	CoC	
Commercial-off-the-shelf (items), Commercial grade item or service	COTS	Item or service commercially available without modification.
Contract		PA, TA or contract
Contractor		An entity that have a contract with IO or DA
Contractor Release Note	CRN	A document to provide a confirmation from a Performer that the products supplied and/or services performed meet the requirements of Contract.
Construction Readiness Review	CRR	
Counterfeit item		Items that are intentionally manufactured, refurbished or altered to imitate original products without authorization in order to pass themselves off as genuine.
Counterfeit / fraudulent / suspect item	CFSI	
Critical quality activity		Any activity or operation that if not performed correctly may affect safety, functionality or reliability.
Domestic Agency	DA	An organization set up under the ITER Framework Agreement to provide goods or services to the IO through Procurement Arrangements (PA) and Task Agreements (TA).
Equipment	PE/NPE	Pressure Equipment or Nuclear Pressure Equipment
Fraudulent items		Items that are intentionally misrepresented with intent to deceive.
ITER Organization	IO	

Inspection Plan	IP	A plan used for the execution and control of Contract activities. It may also be referred to as a Manufacturing and Inspection Plan (MIP), Inspection and Test Plan (ITP), Control Plan (CP), or other similar terms.
Manufacturer		Any natural or legal person who manufactures an equipment or has an equipment designed or manufactured and markets under his name or trademark.
Mechanical Completion Dossier	MCD	
Manufacturing Database	MDB	
Manufacturing Readiness Review	MRR	
Notified Body	NB	Technical organisation approved in an EU state, either for approval and monitoring of the manufacturer's quality assurance system or for direct product inspection for the manufacture of Pressure Equipment.
Performer		An all-inclusive term used to cover DAs, contractors and subcontractors
Procurement Arrangement	PA	
Quality Class	QC	
Quality plan	QP	Document describing the operational quality system to ensure that Contract requirements will be met, and that evidence of such compliance will be maintained. It covers the whole scope of the Contract including work performed by contractors/subcontractors and addresses all activities performed in connection with the Contract.
Protection Important Component	PIC	As per INB Order (French Order of 07/02/2012)
Responsible Officer	RO	IO primary point of contact to manage a Contract.
Structures, systems and components	SSC	
Subcontractor		An entity that performs work for contractors
Suspect items		Items where there is an indication or suspicion that it may not be genuine.
Task Agreement	TA	

3 References

[1]	Quality Classification Determination (24VQES rev. 6.0 or consequent)
[2]	ITER Quality Assurance Program (QAP) (22K4QX)

[3]	Qualification of Protection Important Components (PIC) (XB5ABP)
[4]	Working Instruction for Processing Construction Nonconformities (U8VPSS)
[5]	Procedure for Management of Nonconformities (22F53X)
[6]	Procedure for the management of Deviation Request (2LZJHB)
[7]	Risk and Opportunity Management Procedure (22F4LE)
[8]	Work Instruction for producing an Inspection and Test Plan for construction (UELU9F)
[9]	Working Instruction for Construction Readiness Review (QXW4KQ)
[10]	Working Instruction for Completion Dossier Preparation (UYUSEE)
[11]	Working Instruction for the Delivery Readiness Review (DRR) (X3NEGB)
[12]	Procedure for Transportation of Components to ITER Site (RY5C6Q)
[13]	Procedure for the CAD management plan (2DWU2M)
[14]	Procedure for Analyses and Calculations (22MAL7)
[15]	Design Review Procedure (2832CF)
[16]	Working Instruction for Manufacturing Readiness Review (44SZYP)
[17]	Implementation plan for design & manufacture of PE/NPE (VE2DSP)
[18]	Inspection Plan (IP) Template (QV7GQF)
[19]	Construction Inspection and Test Plan Template (ITP) (TTPQL2)
[20]	Release Note Template (QVEKNQ)

4 Requirement to define quality class (QC)

The quality class of the SSC must be specified in the Contract.

The Performer may grade the SSC quality class specified in the Contract down to the component levels in accordance with reference [1].

The Performer shall inform the IO RO about any downgrade in the quality classification of components.

The Performer may request the IO RO to determine or change the quality class of SSC.

5 Common requirements for QC 1-4

5.1 Quality management system

The Performer shall establish and implement a quality system based on a recognized quality standard and shall meet the requirements outlined in reference [2].

This quality system shall be capable of ensuring that Contract requirements are met, and that evidence of such compliance is maintained.

In case of PA or TA, the Performer shall submit a description of the quality management system for the DA's acceptance. The DA shall forward the accepted description to the IO RO for information.

In the case of a direct contract with IO, the Performer shall submit a description of the quality management system for acceptance by the IO RO.

5.2 Counterfeit, Fraudulent or Suspect Items (CFSI)

The Performer shall prevent CFSI at all levels of operations including

- a) selection of subcontractors
- b) control of externally provided processes, products and services
- d) monitoring and measurement activities

When CFSI are detected, they shall be managed as nonconformities (6.1.3).

5.3 Commercial-off-the-shelf / COTS items

To procure and utilize COTS, controls through dedication method(s) shall be implemented to ensure that the item or service is adequate for its intended function. In particular, for PIC minimum requirements according to reference [3] shall be applied, including requested documentary traceability as applicable.

5.4 Propagation of requirements

The Performer shall ensure that the relevant requirements outlined in this document are communicated throughout their supply chain.

6 Common requirements for QC 1-3

6.1 Contract management (common QC 1-3)

6.1.1 Responsible Officer

The Performer shall appoint a Responsible Officer to:

- communicate with the IO
- coordinate the planning and performance of the work, including work assigned to subcontractors
- maintain time schedules and issue monthly progress reports
- verify that the quality systems are consistently followed during the execution of the Contract
- assess and oversee quality in subcontractor's premises
- monitor the implementation of IO requirements
- provide IO with periodic assessment of quality performance

6.1.2 Quality plan (QP)

The requirements and guidance for the content of QPs are provided in the Annex 1.

The Performer shall prepare a QP for all Contracts when all contractors and subcontractors are identified. Unless specified otherwise, for research and development activities not used for qualification purposes, only the DA (for TA) or the Contractor (for direct contracts) shall prepare a QP.

Subcontractors shall submit QPs to the Contractor for acceptance.

In the case of PA/TA, the Contractor shall submit its own QP and QPs of the subcontractors to the DA for acceptance, and the DA shall then submit all QPs for the IO RO's acceptance.

In the case of direct contract, the Contractor shall submit its own QP and QPs of the subcontractors to the IO RO for acceptance.

The Performer shall revise the QP if changes occur that require it and submit it for acceptance in the same manner as the original plan.

At the IO RO's request, the Performer shall provide the documents referenced in the QP.

The Performer shall carry out the activities in accordance with the QP accepted by IO RO.

6.1.3 Management of nonconformities

For work on the ITER construction site, the Performer shall manage nonconformities in accordance with reference [4].

Otherwise, the Performer shall manage nonconformities in accordance with reference [5].

6.1.4 Management of deviations

To deviate from Contract requirements the Performer shall initiate a deviation request and follow the process in accordance with reference [6].

6.1.5 Risk management

The Performer shall manage risks in accordance with reference [7].

6.1.6 Access to Performer's premises

The Performer shall ensure that the IO/DA representatives and representatives or regulatory bodies have access to the premises when required to oversee or support the work being executed.

6.2 Engineering (common QC 1-3)

The Performer shall have the design approved by design authorities established through controlled procedures.

The Performer shall submit the final design for the IO RO's acceptance.

6.3 Manufacturing, assembly and installation (common QC 1-3)

6.3.1 Inspection and Test Plan (ITP)

For work on the ITER construction site, the Performer shall plan and implement control measures using the Inspection and Test Plan (ITP) in accordance with reference [8].

6.3.2 Readiness Review (CRR)

For work on the ITER construction site, the Performer shall conduct a Construction Readiness Review (CRR) in accordance with reference [9].

6.3.3 Material certificates

The Performer shall submit material certificates to the IO RO for acceptance.

6.3.4 Manufacturing

If the design is included in the Performer's scope of work, the Performer shall not begin manufacturing until the final design has been accepted by the IO RO.

For work on the ITER construction site, the Performer shall treat the mechanical completion dossier (MCD) in accordance with reference [10].

6.4 IO Acceptance (common QC 1-3)

6.4.1 Contractor release note (CRN)

The requirements and guidance for the content of CRNs are provided in the Annex 3.

Prior to factory acceptance, or shipment, if there is no factory acceptance, of products and/or services, the Performer shall certify in the Contractor Release Note (CRN) that all required verifications, inspections, and tests are complete and satisfactory, and that all necessary documentation is available, and shall submit the CRN to the IO RO for acceptance.

6.4.2 Mechanical Completion Dossier (MCD)

For work on the ITER construction site, the Performer shall submit the MCD in accordance with reference [10].

6.5 Storage and shipping (common QC 1-3)

6.5.1 Conditions to ship - CRN and shipping notification

The Performer shall not ship the products prior to the acceptance of the CRN by the IO RO.

The Performer shall submit a shipping notification to the IO RO and shall not ship the products prior to their acceptance by the IO RO.

6.5.2 Conditions to ship - Delivery Readiness Review (DRR)

The Performer shall not ship the products until the Delivery Readiness Review (DRR) is completed in accordance with reference [11].

6.5.3 Shipping

The Performer shall ship the products in accordance with reference [12].

7 Specific requirements for QC 1

7.1 Engineering (extras for QC 1)

The Performer shall submit a request to use software and/or models for design and operations to the IO RO.

The Performer shall manage CAD works and data in accordance with the reference [13].

The Performer shall perform analyses and calculations in accordance with the reference [14].

The Performer shall conduct design reviews in accordance with the reference [15].

7.2 Manufacturing, assembly and installation (extras for QC 1)

7.2.1 Special processes

For special processes, the Performer shall submit qualification documents and records for the IO RO's acceptance.

7.2.2 Preparation and change of inspection plan (IP, MIP/ITP)

For work on the ITER construction site, the Performer plans control measures using the Inspection and Test Plan (ITP) in accordance with chapter 6.3.1 (reference [8]).

Otherwise, the Performer shall plan control measures using generic Inspection Plans (IP) as follows:
The requirements and guidance for the content of IPs are provided in the Annex 2.

When an (Agreed) Notified Body ((A)NB) is involved, the Performer shall submit the IP to the (A)NB before submitting it to DA or IO.

In the case of PA, the Performer shall submit the IP to the DA for marking intervention points. The DA shall then submit the IP to the IO RO for marking interventions and acceptance.

In case of IO direct contracts, the Performer shall directly submit the IP to the IO RO for marking intervention points and acceptance.

At the IO RO's request, the Performer shall provide the documents referenced in the IP.

The Performer may revise the IP if changes are required and shall submit it for acceptance in the same manner as the original plan, unless instructed otherwise in writing by IO RO.

7.2.3 Readiness review (CRR, MRR)

For work on the construction site, the Performer conducts a Construction Readiness Review (CRR) in accordance with chapter 6.3.2 (reference [9]).

Otherwise, the Performer shall conduct manufacturing readiness review (MRR) in accordance with the reference [16].

7.2.4 Execution of IP (MIP/ITP)

For work on the ITER construction site, the Performer implements control measures using the Inspection and Test Plan (ITP) in accordance with chapter 6.3.1 (reference [8]).

Otherwise, the Performer implements control measures using generic Inspection Plans (IP) as follows:

The Performer shall not begin executing activities until the IP is accepted by the IO RO and shall carry out the activities in accordance with the IP once it is accepted.

The Performer shall not begin executing activities until the MRR has been completed.

The Performer shall notify DA and IO of the intervention points before executing the relevant operations as defined in the IP.

The Performer shall ensure that the IP is readily accessible to those performing the work.

The Performer shall ensure that the IP is updated in a timely manner - each operation shall be recorded at least before the next concerned intervention point so that to allow tracking by IO and DAs of IP execution during operation's progress (e.g. by using MDB or other equivalent digitalized tools).

The Performer shall ensure that each operation is signed off and dated by the person in charge of the operation.

The Performer shall ensure that records associated with operations (inspection reports, test reports, nonconformity reports etc.) are properly referenced in the IP and made available by suitable means to the party responsible for the intervention.

The Performer shall ensure that each intervention point is signed off and dated by the person carrying out the intervention. IO Acceptance (extras for QC 1)

7.2.5 Manufacturing dossier

Prior to factory acceptance or shipment (in the absence of factory acceptance) of products, the Performer shall submit the manufacturing dossier to the IO RO.

7.3 Storage and shipping (extras for QC 1)

7.3.1 Storage

The Performer shall store the products in accordance with IO technical specifications provided by the IO RO.

8 Specific requirements for PE/NPE

8.1 Qualification of personnel (PE/NPE)

If IO is the Manufacturer of Equipment, the qualification of Performer's personnel shall be carried out in accordance with the requirements of the reference [17].

8.2 Engineering (extras for PE/NPE)

The Performer shall submit the final design for the IO RO's approval.

8.3 Manufacturing (extras for PE/NPE)

If the design is included in the Performer's scope of work, the Performer shall not begin manufacturing until the final design has been approved by the IO RO.

8.3.1 Special processes

If IO is the Manufacturer of Equipment, the qualification of special processes shall be carried out in accordance with the requirements of the reference [17].

8.3.2 Inspection plan

When IO acts as the manufacturer of Equipment under the scope of Module H, a specific column in the IP shall be dedicated to defining control points related to the implementation of Module H. The column labelled "Third Party" or "Other" in templates [18] or [19] may be used for this purpose.

8.4 Storage and shipping (extras for PE/NPE)

When IO acts as the Manufacturer of Equipment, the procedures related to handling, storage, or shipping shall be approved by the IO RO.

9 Annex 1. Requirements and guidance for the content and structure of Quality Plans (QP)

9.1 Content

Quality Plans shall be brief and to the point, while giving sufficient visibility on the control of the activities to be carried out.

The Quality Plan shall identify:

- the critical quality activities and associated controls
- the specific allocation of resources, duties, responsibilities and authority
- details of all contractors/subcontractors and how interfaces will be managed
- the specific procedures, methods and work instructions to be applied
- the specific methods of communication, both formal and informal, to be established between working groups

The level of detail in the plan shall be consistent with:

- the technical requirements of the Contract
- the safety and operational importance of the items involved
- the complexity of the organizations, functions and activities involved
- the degree of design innovation
- the involvement of innovative processes
- the involvement of processes which cannot be fully verified by inspection or test
- the degree to which functional compliance can be demonstrated by inspection or test
- design, performance or manufacturing margins

Much of the generic documentation needed to prepare the Quality Plan will normally already exist as part of the performer's quality documents and supporting procedures. The Quality Plan need only refer to this documentation and show how it is to be applied to the particular Contract.

The Quality Plan may be a single document that covers the whole scope of the Contract, including work performed by subcontractors. The plan may also be the compilation of coordinated separate and well-defined documents.

9.2 Structure

It is not essential for the Quality Plan to follow the structure outlined below which is given for guidance.

The elements listed in the following sections are neither prescriptive nor exhaustive and shall be addressed only where relevant:

9.2.1 Quality Management

The plan shall:

- identify all critical quality activities and associated controls
- identify the different organizations involved
- detail the breakdown of responsibilities
- identify within the different organizations involved the key individuals responsible for:

- ensuring that the activities performed in connection with the particular Contract are planned, implemented and controlled and their progress monitored
- communicating requirements peculiar to the specific Contract to all affected organizations
- resolving problems that may arise at interfaces between the organisations involved

An organization flow chart could facilitate the understanding.

9.2.2 Contract Review

The plan shall indicate how, when and by whom Contract requirements are to be reviewed and the review recorded.

9.2.3 Document

The plan shall show how, when and by whom documents will be controlled.

9.2.4 Design

The plan shall show how, when and by whom design will be controlled, including:

- when, how and by whom the design process is to be carried out, controlled and documented
- the arrangements for the review, verification and validation of design output conformity to design inputs requirements

Where applicable, the plan shall indicate the extent to which the IO will be involved in design activities, such as participation in design reviews and design verification.

The plan shall reference applicable codes, standards and regulatory requirements.

The plan shall:

- list the computer programs to be used
- indicate how, when and by whom they will be controlled

9.2.5 Procurement

The plan shall show how, when and by whom procurements will be controlled, including:

- any important items or activities that are to be purchased or subcontracted
- the relevant quality assurance requirements
- the proposed contractors or subcontractors
- the methods to be used to evaluate, select and control contractors and subcontractors
- the methods to be used to satisfy regulatory requirements, which apply to, purchased or subcontracted products

9.2.6 Identification and Control of items

Where traceability is a requirement or necessary for the adequate control of the work, the plan shall define its scope and extent, including:

- how affected items are to be identified
- how Contract and regulatory traceability requirements are identified and incorporated into working documents
- what records relating to such traceability are to be generated and how and by whom they are to be controlled

9.2.7 *Manufacture*

The plan shall indicate how processes, manufacture, assembly, inspections and tests will be controlled. Where appropriate, the plan shall introduce or refer to:

- relevant documented procedures and work instructions
- the methods to be used to monitor and control processes
- criteria for workmanship
- use of special and qualified processes and associated personnel
- tools, techniques and methods to be used

9.2.8 *Inspection and Test*

The plan shall show how, when and by whom inspection and test would be controlled, including:

- any inspection and test plan to be used, and how and by whom they are reviewed and approved
- how and by whom inspection and test reports are reviewed and approved
- acceptance criteria to be applied
- acceptance of purchased or subcontracted items
- any specific requirements for the identification of inspections and tests status
- the extent to which the IO and (Agreed) Notified Bodies will be involved, such as witnessing inspection and test

9.2.9 *Measuring and Test equipment*

The plan shall indicate the control system to be used for measuring and test equipment specifically used in connection with the particular Contract, including:

- identification of such equipment
- method of calibration
- method of indicating and recording calibration status

9.2.10 *Handling, Storage, Packing, Shipping and Delivery*

The plan shall show how, when and by whom handling, storage, packing, shipping and delivery will be controlled:

- how Contract requirements for handling, storage, packaging and shipping are to be met
- how the item will be delivered to the specified site in a manner that will ensure that its required characteristics are not degraded

9.2.11 *Records*

The plan shall indicate:

- how records are to be controlled, including how legibility, storage and retrievability will be satisfied
- what records are to be kept
- what records are to be supplied to the IO, when and by what means
- how and by whom the records are reviewed and approved prior to inclusion in the deliverables handed over to the IO
- what form the records will take (such as paper, microfilm, tape, disc or other medium) and in what language the records will be provided

9.2.12 Deviations and Nonconformities

The plan shall indicate how, when and by whom deviations and non-conformances will be processed including those originating from contractors and subcontractors.

9.2.13 Training and Qualification

The plan shall address:

- any specific training requirement for personnel
- how such training is accomplished and recorded

9.2.14 Statistical Techniques

Where statistical techniques are relevant for establishing, controlling and verifying process capability and item characteristics, they shall be indicated in the plan.

9.2.15 Assessment

The plan shall indicate how, when and by whom the implementation and effectiveness of the Quality Plan will be monitored.

10 Annex 2. Requirements and guidance for the content of Inspection Plans (IP)

An IP shall identify:

- Requirements and instructions applicable to those operations
- Operations to be inspected or witnessed by DA, IO and (Agreed) Notified Body ((A)NB).
- Documents providing traceability and recording of the verification and completion of these operations.

The level of detail in the IP shall be such as to prevent the inadvertent bypassing of quality activities and to enable adequate planning, monitoring and verification of operations.

The IP shall be written in English for IO and, if necessary, in Performer's working language to be easily understood by those carrying out the work.

The IP shall identify who is performing each intervention point.

A suggested format for the IP can be found at the IP template [18]. Alternative formats (including in electronic form) may be acceptable at discretion of IO RO in advance of their intended use.

11 Annex 3. Requirements and guidance for the content of Contractor Release Notes (CRN)

The Release Note shall be prepared using the Release Note template [20].

The Release Note shall:

- Certify that the product or service meets the Contract requirements
- List the documents and records constituting the manufacturing dossier and their status
- List any outstanding obligations

The list of documents and records below is non-exhaustive and shall be tailored to meet the Contract requirements.

1. Management Documents:
 - Quality Plan
 - List of contractors/subcontractors
2. Raw Materials - Metals, Ceramics and Other Materials
 - Procurement Specifications
 - Sub-Orders
 - Material Certification traceable to components
3. Manufacturing Documents
 - Fabrication Procedures (machining, forming, soldering, wiring)
 - Welding/Brazing Documents (WPS, PQR, WPQ etc...)
 - Weld Plan
 - Weld Inspection Record
 - Non-Destructive Examination Procedures (VT, PT, MT, RT, UT etc...)
 - Cleaning procedure
 - Surface Treatment Specification
4. Assembly and Test Documents
 - Assembly Sequences, Control Specifications and Procedures
 - Pressure Test Procedure
 - Helium Leak test procedure
 - Function Test Specifications
 - Control Reports (Visual Examination, Non-Destructive Examination, Electrical and
 - Insulation Tests, Leak Tests, Pressure Test, Certification of Cleanliness, etc.).
 - Deviation and Nonconformity Reports
 - Completed Manufacturing & Inspection Plan(s)
 - Drawings marked “As Built”

IDM UID 2LZJHB
VERSION CREATED ON / VERSION / STATUS 17 Dec 2024 / 9.1 / Approved
EXTERNAL REFERENCE / VERSION

MQP Level 3

Procedure for the management of Deviation Request

The purpose of this document is to describe the Deviation Request (DR) processes to be followed for the ITER project. This procedure defines the requirements and provides the detailed workflows for management of DRs project wise addressed to and generated by the ITER Organization.

Approval Process			
	Name	Action	Affiliation
Author	Redon T.	17 Dec 2024:signed	IO/DG/ESD/DO/ICAS
Co-Authors	Clochard V.	17 Dec 2024:signed	IO/DG/SID/CID/CMS
Reviewers	Bartels H.- W.	07 Jan 2025:recommended	IO/DG/SID/CID
	Cortes P.	07 Jan 2025:recommended	IO/DG/SID/CID/NSI
	Jung C. Y.	19 Dec 2024:recommended	IO/DG/SQD/QMD
	Khomutnikov A.	06 Jan 2025:recommended	IO/DG/SQD/QMD
	Perrier G.		IO/DG/SQD
Approver	Orlandi S.	15 Jan 2025:approved	IO/DG/CP
Information Protection Level: Non-Public - Unclassified RO: Khomutnikov Aleksei			
Read Access	LG: Quality Control Group, AD: ITER, AD: External Collaborators, AD: IO_Director-General, AD: External Management Advisory Board, AD: IDM_Controller, AD: OBS - Quality Management Division (QMD) - EXT, AD: Nuclear Safety Inspectors, AD: OBS - Quality Management Division (QMD), AD: DA, AD: Auditors, A...		

#drn#

Change Log			
Procedure for the management of Deviation Request (2LZJHB)			
Version	Latest Status	Issue Date	Description of Change
v1.0	Signed	02 Jun 2009	
v1.1	Approved	10 Jun 2009	Minor change in para 4.1.2 at the request of SAS DGG
v2.0	In Work	26 Oct 2010	- General revision showing IDM review & approval for Deviation Requests - Incorporated Domestic Agencies in review process for Deviation Requests
v2.1	In Work	27 Oct 2010	New lay-out through IDM auto-generated covering page.
v2.2	Approved	22 Dec 2010	Changed from "DDG/Directorate Head" to "Directorate Head" on para. 4.1.3 , 4.2.2 and Appendix A.
v3.0	Signed	22 Sep 2011	Introduction of a filter for deviations affecting Regulatory Files
v3.1	Approved	22 Sep 2011	Minor change to tidy up role activity chart
v4.0	Approved	04 Sep 2013	- modification of title - modification of the flow chart for DR - addition of a flow chart for NCR - addition of the following steps for NCR: root cause analysis, corrective action (if needed) and closure of NCR
v4.1	Approved	25 Jul 2014	- Scope: include addition of a requirement - WBS RO and TRO change to IO RO and acronym with definition added - Responsibilities: addition of any dispute solved by Head of QA - Flow chart: refer to paragraph listing the reviewer 7.1.4 for DR and 7.2.1.4 for - Flow chart: addition of root cause analysis for NCR - Addition of "Send a link of the signed form to DAs if they are impacted" for DR and NCR - Modification of the paragraphs of the text to be coherent with the flow charts
v4.2	Approved	12 Mar 2015	Changes according to MQP doc Request - QV6CHN: - Update of title "Procedure for IO Deviation Request and Non-conformance Report" - Addition of an explanatory footnote for PIC and PIA - Addition of PIA with PIC - Addition of details for the steps in IDM for the closure of NCRs
v5.0	In Work	01 Sep 2017	The purpose of this document is to specify the Deviation Request, hereinafter DR, processes from the initiation to the implementation. The processes for following two types of DR's are described: - Deviation Request issued by DA, (Sub-)Contractor and/or Supplier, hereinafter "DA/CON-DR," and - Deviation Request issued by IO, hereinafter "IO-DR" Roles and/or responsibilities of each stakeholder are also specified.
v5.1	Signed	01 Sep 2017	Compared to the Version 4.2: - DR and NCR processes are separated. - IO technical change request is out of scope. - Work flow and responsibilities are specified clearly. - Criteria for the escalation is specified. - Added all required contents in the new template, MQP Document Template (ITER_D_438T76 v2.5)
v5.2	Signed	20 Sep 2017	Implemented QA Process Owner's comment regarding the approvers. In this version, the approvers are as specified in; <u>Sign-Off_Authority_for_Project_Documents_2EXFXU_v3_3</u>
v5.3	Approved	25 Sep 2017	As commented by CIO/CMD head, rev. nums. of the latest approved versions of the applicable documents are added.
v5.4	Approved	15 Dec 2017	Revision of the flowcharts The flowcharts are revised back into the ones in [2LZJHB v4.2], which had

			been accepted by ASN The specific changes are: 1) "IO-SRO" is replaced by "EPNS-DH" 2) Logic in the flowcharts, e.g. explicit description for escalation to PCR, safety pre-assessment first. Revised user-friendly 1) Basic principle (definition, rule, criteria), process flow and responsibility assignment are separated clearly by section. 2) Deleted needless and/or non-mandatory contents, e.g. some foot notes, KPI. 3) Flowcharts, description of the process steps, and responsibility assignment (RACI matrix) are correlated by paragraph number, #.#.#. 4) Some TYPOs are fixed.
v5.5	Approved	14 Mar 2018	1) "Approval with condition is not allowed" is changed into more realistic statements: • Regarding DA/CON-DR, all conditions shall be documented and agreed between the DA officer representing the initiator and the approver via exchanges in IO-IDM metadata. In case of direct contract between IO and CON, the initiator and the approver shall agree on. • Regarding IO-DR, all conditions shall be documented and agreed between the approver and the acceptor, who are IO-CT and DA/CON, respectively. 2) Mandatory and optional reviewers are specified as in Section 7.2. Added some statements telling "SOA [22F4E5] to be consistent later."
v5.6	Revision Required	11 May 2018	As per MQP doc Request - WK73BR Includes Module H needs
v6.0	Revision Required	07 May 2019	Chapter 2.1 to clarify the scope of DR in relationship with MQP procedures changes. CMA audit finding (NC 02) regarding DR scope ITER_D_XYKVBE - Quality Audit Report_IO-QMSA-18-08-CMA Audit Chapter 3.1 - add definition of Equipment, Manufacturer, PE/ NPE and ESPN – maintained as per previous revision of procedure in the scope of PE/ NPE network. Chapter 3.2 – add abbreviation PT- project team Chapter 4.2 – add references - maintained as per previous revision of procedure in the scope of PE/ NPE network. [11] French Order dated 30 December 2015 concerning Nuclear Pressure Equipment [12] Implementation plan for design & manufacture of PE/NPE [VE2DSP] Chapter 5 - add reference to other specific Sign-Off Authority related to PT and construction and PE / NPE responsibilities - maintained as per previous revision of procedure in the scope of PE/ NPE network. Chapter 6.2.2 – add reference to other specific Sign-Off Authority related to PT and construction Chapter 6.3.3 - add reference to other specific Sign-Off Authority related to PT and construction Chapter 7 add reference to other specific Sign-Off Authority related to PT and construction and PE / NPE responsibilities - maintained as per previous revision of procedure in the scope of PE/ NPE network. Table of Mandatory or Optional Reviewers improved - add PT staff review and PE/ NPE review - maintained as per previous revision of procedure in the scope of PE/ NPE network. Eliminate RACI tables.
v7.0	Signed	14 Jun 2019	New version according to additional MQP doc Request - YPKLTV and and essential data YTKAKK, which are documenting list of changes as per reviewers comments.
v7.1	Signed	16 Jul 2019	Revision required for implementation of reviewer comments.

			The following changes/ clarifications are applied: - Chapter 2 - Scope of procedure - add clarifications to allow IO to raise DR for technical deviations with no impact on cost, schedule and without changing the PAs documentation - Main, annex B , annex A) - Chapter 2.1 - add clarifications to eliminate the discrepancies with DR definition - Chapter 3.1 - Chapter 3.1 - clarify definition of "Equipment". Add clarification for Deviation request definition to eliminate conflicts with chapter 2.1 requirements. - Chapter 5 - first bullet - add clarification regarding deviation to IO requirements. - Chapter 6.2.10 - Confirmation of DR implementation. add clarification regarding criteria for "required" DR implementation confirmation. - Chapter 9 - correction chapter numbering (9.1, 9.2 9.3 and 9.4) - F4E comments regarding interface with Supply process / application of PA change notice are implemented in the chapter 2.1 and chapter 9.
v7.2	Signed	18 Jul 2019	The following minor changes are applied: - Chapter 5 - Basic principle - eliminate 7th bullet regarding IO DR. - Fig 6.2 - Work flowchart of IO -DR - add clarification: Not applicable in the scope of PA changes - Chapter 6.3.3 - IO -DR Decision - Eliminate DA / CON responsibilities for decision since IO-DR is not applicable for PA changes. - Chapter 7 - Mandatory or Optional Reviewers - for IO-DR the responsibility for DA-RO review is Optional instead of Mandatory (IO-DR is not applicable for PA changes)
v7.3	Approved	18 Jul 2019	New version according to additional MQP doc Request - YPKLTV and and essential data YTKAKK, which are documenting list of changes as per reviewers comments The following minor changes are applied: - Chapter 5 - Basic principle - eliminate 7th bullet regarding IO DR. - Fig 6.2 - Work flowchart of IO -DR - add clarification: Not applicable in the scope of PA changes - Chapter 6.3.3 - IO -DR Decision - Eliminate DA / CON responsibilities for decision since IO-DR is not applicable for PA changes. - Chapter 7 - Mandatory or Optional Reviewers - for IO-DR the responsibility
v8.0	In Work	25 Nov 2019	As per approved MQP doc request https://user.iter.org/?uid=27JZVH the main changes are: - Clarification of the DA/CONT DR and IO-DR workflows (even though no major steps were added or removed); - Clarification of the roles of approvers for the DA/CONT DR and IO-DRs; - Inclusion of the IO supplier DR to IO, that follows the same process as the DA DR; - Clarification of the text, notably sects. Main principles and main requirements; - Editorial changes, which make the procedure much easier to understand and implement;
v8.1	Approved	25 Nov 2019	Minor update due to technical problem with pdf conversion. All changes are listed for the previous version 8.0
v9.0	Signed	10 Dec 2024	In accordance with CSAJJV the changes are: - Update due to the ASN Decision 2017-DC-0616 of November 30, 2017 amended by Decision 2023-DC-0770 on noticeable modifications to INBs (C58DCJ): any DR that is categorized as a Noticeable Modification shall trigger a PCR - Update due to the NCR-IO.NCR-0171 - SRO review of Deviation Request (8TZQDH): clarification that the DR review by the SRO is mandatory only

			when PIC/PIA are impacted - New mandatory field introduced: Impacted Requirement Document - Approver for DR purely related to MQP process is changed from the MQP Process Owner to the approver of the MQP document from which the DR requests to deviate. The MQP Process Owner is now a mandatory reviewer - CID Head removed as mandatory reviewer - SIROs added as mandatory reviewers - CMS Section Leader added as observer - The DR Database, which today is used for IO Supplier DR only, is recommended to be used as well for DA-DR and IO-DR - Addition of the section 8.4 Interactions with MQP Process Management Process: it is recommended, but not mandatory, to apply the DR procedure to track any deviation to MQP requirement - Use of the MQP Document Template 438T76 v5.0 - Integration of various needs consolidated in CAT-4915
v9.1	Approved	17 Dec 2024	Changes compared to the last approved version v8.1 are those described in the Version Change Description of the v9.0, plus the following additional changes from v9.0 to v9.1: - In accordance with the MQP Process Management Process, for DRs related to the MQP process, impacted original document's stakeholders are mandatory reviewers of the DR - For IO-DRs related to the MQP process, the first check (step 4) can be done by the MQP Process Representative instead of the MQP Requirement Document Approver

Table of Contents

1	PURPOSE	2
2	SCOPE.....	2
3	DEFINITIONS AND ACRONYMS	2
4	REFERENCES	3
5	GENERAL PRINCIPLES	3
5.1	MAIN PRINCIPLES	3
5.2	MAIN REQUIREMENTS	4
6	WORKFLOW.....	6
6.1	FLOWCHART.....	6
6.2	RESPONSIBILITIES	9
6.3	DESCRIPTION OF STEPS.....	9
6.3.1	<i>DA/CONT-DR Process</i>	9
6.3.1.1	Submission.....	9
6.3.1.2	Review	9
6.3.1.3	Decision, Dispute and Resolution.....	11
6.3.1.4	Closure	12
6.3.2	<i>IO-DR Process</i>	12
6.3.2.1	Submission.....	12
6.3.2.2	Review	12
6.3.2.3	Decision, Dispute and Resolution.....	13
6.3.2.4	Closure	13
7	RECORDS.....	13
8	INTERACTIONS WITH OTHER PROCESSES.....	14
8.1	INTERACTIONS WITH THE DESIGN CONTROL PROCESS	14
8.2	INTERACTIONS WITH THE SUPPLY PROCESS	14
8.3	INTERACTIONS WITH NUCLEAR SAFETY PROCESSES	14
8.4	INTERACTIONS WITH MQP PROCESS MANAGEMENT PROCESS.....	14

1 Purpose

The purpose of this document is to describe the Deviation Request (DR) processes to be followed for the ITER project. This procedure defines the requirements and provides the detailed workflows for management of DRs project wise addressed to and generated by the ITER Organisation.

2 Scope

This procedure is a MQP Level-3 document within the process of Configuration Management (QAP sect. 3.1, ref. [1]), as shown in the Management and Quality Programme (MQP) map:

<https://portal.iter.org/qa/SitePages/Home.aspx>.

This procedure shall be applicable for managing the following DRs:

- **Deviation Requests from DAs to IO:** e.g. deviations from the PA baseline. To be noted that DAs follow their internal processes to manage the first steps of this procedure as well as their Supplier Deviation Requests;
- **Deviation requests from IO suppliers to IO:** e.g. deviations from IO supplier contract baseline for In-Cash contracts;
Note: Hereby, the deviation requests from DA to IO, and IO suppliers to IO, are commonly defined as the DA/CONT-DR process, see sect. 6.3.1.
- **IO Deviation Requests:** deviations from defined requirement(s) or punctual departures from the authorized high level configuration documentation belonging to the ITER Technical and/or Management baselines (e.g. ASN approved safety files, Project Requirements (PR)).
Note: This DR process is known as IO-DR, for the remaining of the document, see sect. 6.3.2.

3 Definitions and acronyms

The definitions of the configuration management terms used in this procedure are given in the Configuration Management Glossary, ref. [2].

Acronym	Definition
ANB	Agreed Notified Body
CID	Central Integration Division
CONT	Contractor (i.e. supplier of IO, excluding DAs)
CMS	Configuration Management Section
DA/CONT-DR	Domestic Agency/Contractor – Deviation request
DA PA TRO	DA Procurement Arrangement Technical Responsible Officer
DR	Deviation Request
ESR	Essential Safety Requirement
IO Contract RO	ITER Organization Contract Responsible Officer
IO-DIRO	IO Design Integration Responsible Officer
IO-DR	ITER Organization Deviation Request
IO-PARO	IO Procurement Arrangement Responsible Officer
IO PA TRO	ITER Organization Procurement Arrangement Technical Responsible Officer
IO-QARO	IO Quality Assurance Responsible Officer

IO-SIRO	IO System Integration Responsible Officer
IO-SRO	IO Safety Responsible Officer
IO-TRO	IO Technical Responsible Officer
MQP	Management and Quality Programme
PA	Procurement Arrangement
PA-CN	Procurement Arrangement Change Notice
PIA	Protection Important Activity
PIC	Protection Important Component
PCR	Project Change Request
PT	Project Team
QAP	Quality Assurance Program
SIC	Safety Important Class
SL	Section Leader

4 References

[1]	ITER Quality Assurance Program (QAP) (22K4QX)
[2]	Configuration Management Glossary (X2SH46)
[3]	Procedure for the Preparation, Review, Approval, Award and Amendment of Procurement Arrangements (2W4F7A)
[4]	IO Deviation Request Template (2LRNQP)
[5]	Project Change Procedure (22F4E5)
[6]	Procedure for Configuration Control, Review and Audit (TZY7YV)
[7]	Sign-Off Authority (SOA) for Project Documents (2EXFXU)
[8]	Procedure for the Management of Safety Modifications (U34EB9)
[9]	Pressure Equipment Directive 2014/68/UE (RZ6PAK)
[10]	French Order dated 30 December 2015 concerning Nuclear Pressure Equipment (SMP384)
[11]	Implementation plan for design & manufacture of PE/NPE (VE2DSP)
[12]	Design Planning Procedure (U34ACR)
[13]	Design Change Control Procedure (U2QPDS)
[14]	ITER Integrated Safety, Environment and Security Management System (ISMS) Manual (4HCWJU)
[15]	In-Cash Procurement Procedure (658PD4)
[16]	MQP Process Management Procedure (7M445D)

5 General principles

5.1 Main principles

The main principles that shall be respected for management of a DR are as follows:

- i. The DAs, suppliers of IO, and IO staff, can issue DRs for IO Approval.

- ii. As per ref. [2], DRs are punctual departures from a particular requirement(s) from the current authorized configuration documentation and prior to the execution of the actions that have an impact on meeting the original specified requirement(s).

Note: A deviation permit is generally given for a limited quantity of items, period of time, and for a specific use.

- iii. The DR process for both DA/CONT-DR and IO-DRs is composed of four main steps:
 - 1) **Submission**, see sect. 6.3.1.1 and 6.3.2.1
 - 2) **Review**, see sect. 6.3.1.2 and 6.3.2.2
 - 3) **Decision, dispute and resolution**, see sect. 6.3.1.3 and 6.3.2.3
 - 4) **Closure**, see sect. 6.3.1.4 and 6.3.2.4.
- iv. DRs can impact different authorized configuration documentation (e.g. the PA baseline, the ITER technical baseline, etc.) depending on the DR submitter (see chapter 6).
- v. DRs shall be managed using a dedicated IT system (DR Database¹ or IDM) from initial submission to closure, as per guidelines given in this procedure.

Note: DAs can use their internal IT applications/platforms to manage DRs before submission to IO.

5.2 Main requirements

- i. Deviation Requests shall be submitted for IO review and approval/rejection before implementation of related activity(ies) (e.g. manufacture of the item).
- ii. Before submission to IO, the DA/CONT DRs shall be internally reviewed by competent and authorised specialist(s) of the DA/supplier and approved for the submission to IO.
- iii. IO DRs shall not be used to request to deviate from an agreed PA baseline or IO direct contracts (In-Cash contracts).

Note: IO requested changes impacting PAs, shall be managed according to the procedure Preparation, Review, Approval, Award and Amendment of Procurements Arrangements (PA), ref. [3]. In line with this procedure, in most cases the vehicle for changing PA baselines is the PA Change Notice (PA-CN).

Note: IO requested changes impacting IO direct contracts (e.g. In-Cash contracts), shall be managed according to the In-Cash Procurement Procedure, ref. [15].

- iv. The DRs shall be issued using the DR Database or the DR Template (ref. [4]). If applicable, the DA/CONTs can provide their DRs using their internal template (ensuring that the file contains the IO cover page), as follows:
 - Upload the internally approved DR into IDM so that the DR has a well-defined UID.
 - Ensure that the DR respects the mandatory information as per sect. 5.2 v. of this procedure;
- v. DR submitted forms shall contain (as a minimum) the information requested in the DR Template (ref. [4])”:
 - **Type of DR:** either DA, supplier of IO or IO submitter;
 - **DR Reference Number;**

¹ A DR Database (<https://user.iter.org/default.aspx?uid=FA2VRS>) is currently in place to support IO construction sub-contractors DRs. It is strongly recommended that this DR Database be used for DA-DR and IO-DR as well.

- **DR Title;**
- **Type of Impact:** item or MQP process;
- **Quality Class (QC²)**
Note: For DRs impacting more than one activity or component with different QC classes, the submitter shall choose the highest QC in the DR Template (ref. [4]). A detailed description of the components impacted with individual QCs shall be provided in sect. 2 (Description of deviation) of the DR template (ref. [4]).
- **Safety Class:** SIC-1, SIC-2, SR, Non-SIC, PIA if applicable; For activities or components with different safety classes, the same approach as for QC applies.
- **IO PE or NPE:** yes/no, incl. PE/NPE, pressure category and radioactive level (N2-N3).
- **Impacted Requirement Document:** provide the reference, with a clear link to the IDM UID, of the document that contains the requirement(s) from which the submitter requests to deviate.
Note: this can be a technical requirement document (such as a System Requirement Document, a Technical Specification, etc.) or a process requirement document (MQP document).
Note: there may be several Impacted Requirement Documents, in such case they shall all be listed.
- **Description of Deviation:** provide a clear description (and indicate the document IDM UID) of the original requirement(s) (before), the proposed alternative requirement(s) (after), and a detailed justification for the proposed departure (e.g. impact on critical path, etc.). In addition, provide a detailed safety justification if PIC/PIA are impacted.
- **Impact Assessment:** expected additional technical impacts to the best knowledge of the submitter, including an assessment of other impacted PBS, PAs, performance, maintainability, operability, reliability, etc., if known. All impacts shall be assessed, including cost, schedule, performance and logistics.
- **List of expected impacted documents:** exhaustive list of all documents with a clear link to the document IDM UID to the best knowledge of the submitter, that are expected to be impacted should the DR be approved. The impacted documents are technical documentation that uses as input the requirement(s) that the submitter request to deviate from.

vi. **DRs shall not:**

- Lead to a modification of the Performance Baseline. The ITER Performance Baseline is the authorized configuration that comprises the ITER integrated cost, schedule and scope documentation.
- Constitute a permanent change to a document of the ITER Technical Baseline. If a DR leads to a permanent change of the ITER Technical Baseline, a Project Change Request (PCR, see ref. [5]) shall be triggered prior to acceptance of the change. The rationale for the request of a PCR is detailed in sect. 6.3.1.2.

Note: Changes impacting one of the ITER Project's baselines shall be managed using the Configuration Control procedure, ref. [6].

² Quality Class to be determined as per the Quality Classification Determination document.

6 Workflow

6.1 Flowchart

The flowcharts for the DA/CONT-DR and IO-DR processes are shown in Figure 1 and Figure 2 below.

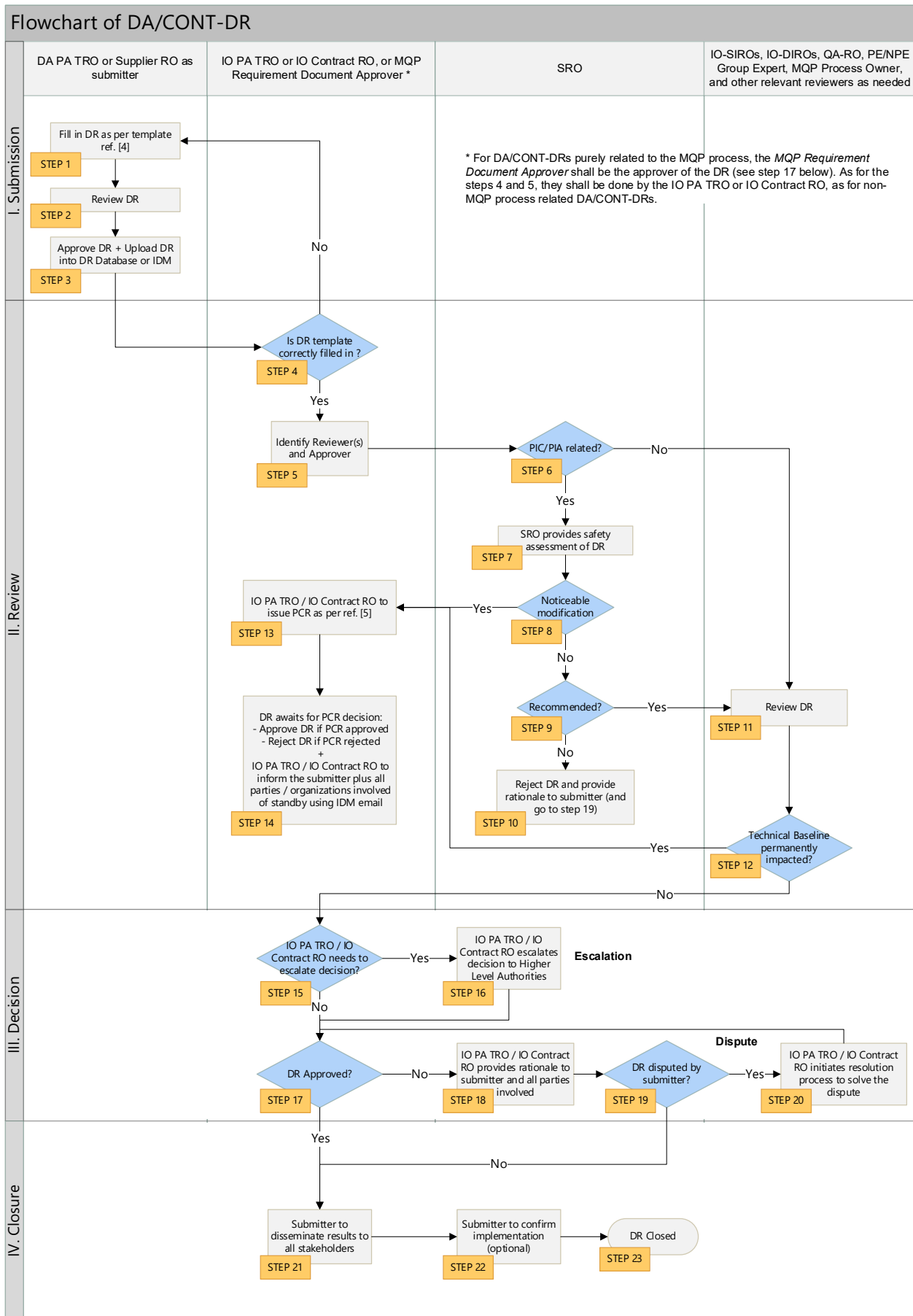


Figure 1 - Flowchart of DA/CONT-DR.

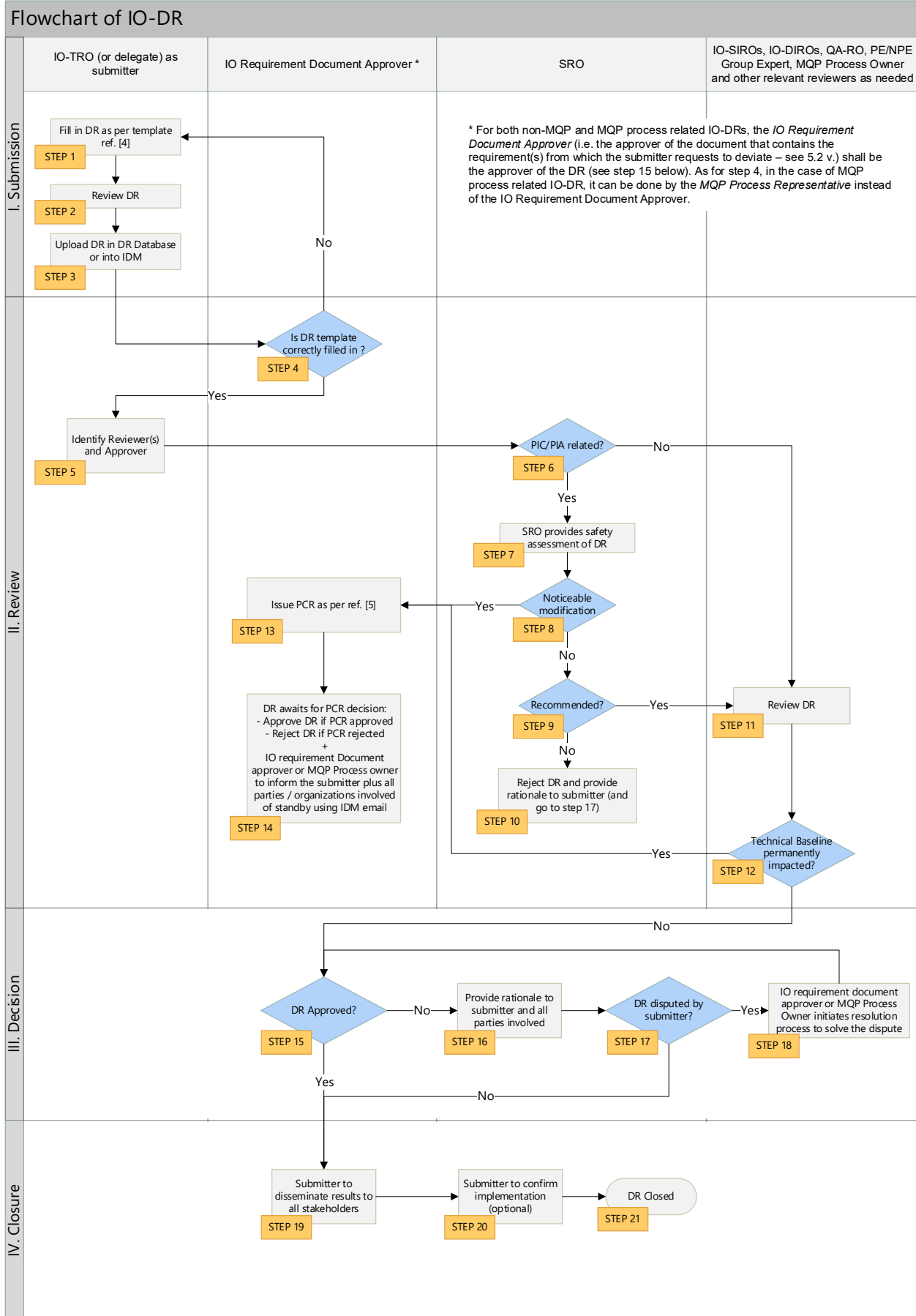


Figure 2 - Flowchart of IO-DR.

6.2 Responsibilities

The main responsibilities for the roles described in this procedure are described in sections 6.3.1 and 6.3.2.

The main roles covered in this procedure are:

- DA PA TRO, Supplier RO or IO TRO (as submitters)
- IO PA TRO or IO Contract RO
- DIRO, SIRO
- IO Expert, PE/NPE Group Expert, etc. as needed
- QARO
- SRO
- IO Requirement Document Approver
- MQP Process Owner, MQP Process Representative and other MQP stakeholders

6.3 Description of steps

6.3.1 DA/CONT-DR Process

Below we describe the tasks to be executed for each of the four main steps of the DA/CONT-DR (see Figure 1).

6.3.1.1 Submission

The DA PA TRO or the Supplier RO (submitters) shall:

- **Step 1:** Identify the necessity for a DR from a PA or contract baseline and initiate the request by using the DR Database or by following the DR template (ref. [4]).
The DAs or suppliers can provide their DRs using their internal template, as described in sect. 5.2 Main Requirements (iv).
- **Step 2:** Review the DR for technical coherence, completeness and clarity, according to the relevant DA or Supplier internal procedures, prior to the submission to IO.
- **Step 3:** The DA PA TRO or Supplier RO line manager shall approve the DR before submission to IO and shall upload the DR template into the IT tool IDM (if the DR Database was not used).

6.3.1.2 Review

- **Steps 4 and 5: The IO PA TRO or IO Contract RO shall provide the first check by reviewing the DR submitted form for completeness and appropriateness, and verify that it is in agreement with the main requirements as per Sect. 5.2 of this procedure:**
 - If DR submitted form is correctly filled in, the IO PA TRO or Contract RO identifies the appropriate reviewers. The mandatory reviewers are:
 - SRO, if protection important components or activities are impacted (i.e. PIC/PIA ticked in the DR template ref. [4])
 - QARO
 - DIRO
 - SIRO
 - PE/NPE Group Expert (when ITER acts as manufacturer of PE/NPE equipment)

- IO experts, if the field of concerned expertise is not covered by the mandatory reviewers and the approver
 - MQP process owner (or delegate), as well as the authors & reviewers of the MQP document from which the DR requests to deviate, if the DR is related to an MQP process.
 - Once reviewers are assigned, the IO PA TRO or IO Contract RO shall inform all reviewers that the review process has started using the IDM email function.
 - If the DR is not correctly filled-in, the IO PA TRO or IO Contract RO shall request further processing to the DA PA TRO or Supplier RO submitter.
 - The CMS-SL (or delegate) shall be added as observer.
- **Steps 6, 7, 8 and 9: If protection important components or activities are impacted, the SRO shall review as follows:**
 - Verify all impacts on regulatory, safety or environmental requirements, and provide the safety and environmental assessment in the DR template (ref. [4]). This assessment shall include the determination whether the proposed deviation constitutes a noticeable modification or, on the contrary, a non-noticeable modification, as defined in ref. [8];
 - Either:
 - Inform the IO PA TRO or Contract RO to trigger the PCR process, in case the deviation constitutes a noticeable modification, as follows:
 - Issue a PCR, as per ref. [5]. The PCR decision shall be registered in the DR template form (Step 13);
 - Maintain the DR is standby awaiting PCR decision and provide the rationale for the decision to issue the PCR to the submitter and all involved parties (Step 14);
 - Or recommend the DR;
 - Or reject (unless revised) the DR and provide rationale for the decision (see step 10).
 - If IO acts as a manufacturer of PE/NPE equipment, the PE/NPE Group Expert shall verify impacts on Essential Safety Requirements (ESR) (see ref. [9] and [10]) and quality requirements as defined in ref. [11], and assess if the DR shall be transmitted to the ANB.
- **Steps 11 and 12: The IO DIROs, SIROs and other technical reviewers as needed shall review the DR in order to:**
 - Ensure that the DR is technically justified and all requirements as per sect. 5.2 are respected;
 - Assess the technical aspects from system integration/configuration management point of view and provide the System/Design Integration assessment as needed, in the DR template.

Note: The IO DIRO and SIRO shall ensure that the approved DRs are captured in the system configurations.

 - Verify if the DR impacts on ITER system level performance, reliability, operability, and interfaces, as needed;
 - Verify if the submitted DR impacts permanently any document from the ITER Technical Baseline.

- **If the IO DIRO or SIRO estimates that the requested deviation constitutes a permanent impact to the ITER Technical Baseline, he/she informs the IO PA TRO or Contract RO to trigger the PCR process, as follows:**
 - Issue a PCR, as per ref. [5]. The PCR decision shall be registered in the DR template form (Step 13);
 - Maintain the DR is standby awaiting PCR decision and provide the rationale for the decision to issue the PCR to the submitter and all involved parties (Step 14);

Note: the DA is also entitled to trigger directly the PCR process.

- IO-QARO shall check the compliance of the submitted DR against the requirements in this procedure, the assignment of QC as per Quality Classification documentation, the assigned reviewers or approver according to this procedure, and the compliance against other concerned quality documents, e.g. Quality Plan, and other specific Sign-of-Authorities related to Project Teams (PT) and construction.
- Each reviewer shall have ten (10) business days to recommend / disapprove the DR, with a clear explanation. If after 10 days the reviewer has not signed the DR (either recommending or disapproving it) the IO PA TRO or Contract RO shall query as to its status and send an email reminding the reviewer(s) of the missing action.

6.3.1.3 Decision, Dispute and Resolution

- **If protection important components or activities are impacted, the SRO shall decide on the recommendation or rejection of the DR from the safety and environmental point of view:**
 - If recommended, the SRO shall notify the DR submitter of the decision and route it to review from the technical aspects system integration point of view (Step 11).
 - If rejected, the SRO shall provide rationale to submitter and all parties involved using the IT management tool IDM email function (Step 10).
- **Steps 15, 17, 18: For all DRs recommended by the SRO or not impacting protection important components or activities, the IO PA TRO or IO Contract RO (after the technical revision is terminated, Step 11), shall decide on the Approval or Rejection of the DR, and provide a rationale to the DR submitter and all involved parties.** DRs shall only be approved after establishing, through technical knowledge, expertise and experience, or by requesting the expertise of other experts, that approval of the request is acceptable with regards to the PA / CONT objectives and overall project needs;
- **For DA/CONT-DRs related to the MQP process, the approver shall be the IO approver of the MQP document from which the DR requests to deviate.**
- **Step 16:** If the decision related to the DR is above the authority of the IO PA TRO or IO Contract RO, the DR shall be escalated to a higher level authority. Higher level Authorities consist of:
 - Impacted Section Leader, or delegate;
 - Impacted Head of Division/Department or delegate, as appropriate;
- If the DR is rejected, the DA PA TRO or Supplier RO:
 - Shall try to develop an alternative plan that does not require deviation in order to fulfil requirements. If the DA PA TRO or Supplier RO devises an alternative solution that (still) involves a departure from the requirement(s), the IO PA TRO or IO Contract RO shall analyse the request and inform the submitter if this alternative solution can be considered for acceptance.

- If an alternative solution is not suggested, the DA PA TRO or Contractor RO can dispute the decision and liaises with the involved parties for solution seeking.
 - **Step 20:** If the DR is rejected, or a reviewer disapproval rationale is disputed by the initiator and cannot be resolved at the IO PA TRO or IO Contract RO level, they shall initiate a resolution process to solve the dispute, as follows:
 - Appeal to the higher level management for a solution;
 - If not settled, the DR shall be listed in the Project Issue Management (PIM) list: <https://jira.iter.org/secure/RapidBoard.jspa?rapidView=45&projectKey=PIM>.
 - The decision to approve a DR from a DA/Supplier A impacting the scope of a DA/supplier B, with no impacts to the ITER baseline, shall be taken by a higher level authority that has the full overview to make the decision of approving the DR from the DA/Supplier A and trigger a PA Change Notice (see ref. [3]) for the DA/Supplier B without changing the ITER baseline.
- Upon decision, the DA PA TRO or Supplier RO shall inform the submitter of the DR decision taken by using the IDM email function (as long as IDM is the available tool) and distribute the link to higher-level management (e.g. Section Leader, Head of Division), as necessary.
- Estimated time for decision on a DR is 2 weeks. One additional week to be considered if the decision needs to be escalated.

6.3.1.4 Closure

The DA PA TRO or Supplier RO (as submitters) shall:

- **Step 21:** Ensure that the DR decision was disseminated to all stakeholders and provide corrective action as needed.
- Ensure that all impacted documentation (including, document UID) is registered in the DR submitting form (as per sect. 5.2).
- **Step 22:** Confirm the DR implementation (optional), for cases when further critical actions are triggered by DR approval and/or related documentation needs to be revised to reflect the implementation of the deviation. For cases when DR implementation confirmation is required, the DR submitter shall attach all the necessary evidences to demonstrate the implementation.

6.3.2 IO-DR Process

As shown in Figure 2, the IO-DR process is similar to the DA/CONT-DR process except for a few steps as shown below.

6.3.2.1 Submission

Steps 1 to 3: The IO-DR submission process shall be performed similarly to the one described in sect. 6.3.1.1, with a few exceptions:

- The IO TRO (or a delegate) is the submitter of the IO-DRs.
- The IO-DR shall be reviewed internally by the IO-TRO (or a delegate) line manager, e.g. Section Leader or Head of Division/Department, using the IT tool.

6.3.2.2 Review

- **Steps 4 and 5:** The IO requirement document approver (i.e. the document that contains the requirement(s) from which the submitter requests to deviate – see 5.2 v.) shall provide the first check by reviewing the DR submitted form for completeness and appropriateness, and verify that it is in agreement with the main requirements as per sect. 5.2 of this

procedure. For IO-DR related to the MQP process, this check can instead be done by the MQP Process Representative.

- If DR submitted form is correctly filled in, the IO TRO identifies the appropriate reviewers. The mandatory reviewers are:
 - SRO, if protection important components or activities are impacted (i.e. PIC/PIA ticked in the DR template ref. [4])
 - QARO, DIRO, SIRO
 - PE/NPE Group Expert (when ITER acts as manufacturer of PE/NPE equipment)
 - IO experts, if the field of concerned expertise is not covered by the mandatory reviewers and the approver
 - MQP process owner (or delegate), as well as the authors & reviewers of the MQP document from which the DR requests to deviate, if the DR is related to an MQP process.
- Once reviewers are assigned, the IO TRO shall inform all reviewers that the review process has started using the IDM email function.
- If the DR is not correctly filled-in, the IO requirement document approver shall request further processing to the IO TRO submitter.
- The CMS-SL (or delegate) shall be added as observer.
- **Steps 6 to 14:** the other reviewers as necessary, shall execute the same steps as described in sect. 6.3.1.2.

6.3.2.3 *Decision, Dispute and Resolution*

Steps 15 to 18: For the IO-DR, decision, dispute and resolution follow the same steps as given in sect. 6.3.1.3, with the exception that:

- For the IO-DR, a decision shall be taken by the IO Requirement Document Approver (i.e. the document that contains the requirement(s) from which the submitter requests to deviate – see 5.2 v.), both for non-MQP and MQP process related DRs. No escalation is possible.
- If the IO-DR decision is disputed, the IO Document Approver shall initiate a resolution process by following the same steps as given in sect. 6.3.1.3.

6.3.2.4 *Closure*

Steps 19 to 21: For the IO-DR closure, the submitter shall follow the same steps as for the DA/CONT DR described in sect. 6.3.1.4.

7 Records

The expected records from the DR process are provided below.

Record	Template	Place to store	Doc type	Naming convention	Retention period
Deviation Request	Template in ref. [4], or DA/CONT template	DR Database (*) or IDM	DA QA Deviation Request Contractor QA Deviation Request ITER QA Deviation Request	IDM procedures or DR Database	ITER lifetime

(*) <https://user.iter.org/default.aspx?uid=FA2VRS>

8 Interactions with other processes

8.1 Interactions with the Design Control Process

This procedure belongs to the process of Configuration Management (QAP, sec. 3.1, see ref. [1]) and interacts with the process of Design Control (QAP, sect. 3.3, see ref. [1]). The Design Control process provides guidance to the IO PA TRO, IO Contract RO or IO Requirement Document approver for the review of design integration aspects of DRs using the MQP procedures for Design Planning, ref. [12], and Design Change Control, ref. [13], among others.

8.2 Interactions with the Supply Process

This procedure interacts with the Supply process (QAP, sect. 3.4, ref. [1]). IO changes to PAs or IO direct contracts (e.g. In-Cash contracts) shall be managed using the Procedure for the Preparation, Review, Approval, Award and Amendment of Procurement Arrangements (PA), see ref. [3] and the In-Cash Procurement Procedure, see ref. [15].

8.3 Interactions with Nuclear Safety Processes

This process interacts with the Nuclear Safety processes. The Safety RO reviews the DR according to the Procedure for the Management of Safety Modifications (ref. [8]) and to ensure that it complies with the ITER Integrated Safety, Environment and Security Management System (ISMS) Manual (ref. [14]), including the MQP L2 and lower level procedures.

8.4 Interactions with MQP Process Management Process

This process interacts with the MQP Process Management process. As indicated in ref. [16], deviations from MQP should be permissions and not requirements or recommendations. Deviations from MQP shall be reviewed and approved by impacted original document's stakeholders and recorded in IDM. It is recommended to use the current DR Procedure to track any Deviation to MQP requirement.

Deviation Request (DR)

1. General

Type of DR	IO / DA / CON		Issue Date															
DA/ CON / ref. num.																		
DR Title																		
Item/ Component identification																		
Work Activity:																		
	PBS description			PBS number														
Main PBS																		
Quality class (QC)	QC 1: ☐ QC 2: ☐ QC 3: ☐ QC 4: ☐																	
Safety self - assessment by RO	PIC/SIC-1	PIC/SIC-2	Non-SIC	PIA														
	☐	☐	☐	☐														
IO Manufacturer of the Pressure Equipment or Nuclear pressure Equipment	Yes ☐ No ☐	PE ☐ NPE ☐	Pressure Category <table border="1"> <tr> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> <td>☐</td> </tr> <tr> <td>0</td> <td>I</td> <td>II</td> <td>III</td> <td>IV</td> </tr> </table>	☐	☐	☐	☐	☐	0	I	II	III	IV	Radioactive level <table border="1"> <tr> <td>☐</td> <td>☐</td> </tr> <tr> <td>Level N2</td> <td>Level N3</td> </tr> </table>	☐	☐	Level N2	Level N3
☐	☐	☐	☐	☐														
0	I	II	III	IV														
☐	☐																	
Level N2	Level N3																	

2. Description of Deviation

Introduction	
Description of the original requirements (Before)	
Description of the proposed alternative (After)	
Justification (for PIC and PIA, include safety justification)	

Deviation Request (DR)

3. Impact assessment (to be filled by initiator)

Other technical impact	☐	
Cost impact	☐	
Schedule impact	☐	
Impact on interface, other impacted PBS, PA, etc.	☐	
Impacted documents	☐ <i>List impacted document title and Uid + Rev. Num.</i>	
Other impacts	☐	
Follow-up of DR implementation (see note 4*)	Required ☐	Not required ☐

4. Safety and Environmental (Assessment by EPNS-DH – see note 2*)

Assessment result and comments	☐ Escalation required to a EPNS meeting required / ☐ Accepted (No escalation) ☐ Rejection unless revised
--------------------------------	---

5. System / Design Integration (Assessment by IO-DIRO – see note 3*)

Assessment result and comments	☐ Escalation to a PCR required ☐ Accepted (No escalation to PCR required)
--------------------------------	--

6. Decisions

	Name	Signature*	Date	Decision
Initiator				
CON RO				
DA RO				
IO-Approver				☐ Approve * ☐ Reject *

7. Confirmation of Implementation (if required – see section 3 – impact assessment)

	Name	Signature*	Date
CON-RO			
DA RO			
IO-Approver			

8. List of Attachment

--

Note *:

- Signature of DR and confirmation of IO decision (reject/ accepted) are mandatory required. IDM system may be used for DR review and approval signatures (DR shall indicate the reviewers / approver names and date).
- EPNS-DH (delegated SRO) assessment will be recorded in IDM system – with a clear resolution if DR is rejected/escalated.
- DIRO assessment will be recorded in IDM system. If escalation to PCR is required then the section 5 of DR shall be mandatory filled.
- The DR implementation confirmation “is required” typically for the cases when further critical actions are triggered by DR approval and/ or related documentation need to be revised to reflect the deviation implementation.

MQP Level 2

Procedure for Management of Nonconformities

The purpose of this document is to specify the Nonconformity Management process, hereinafter NC from the Initiation to the Closure in the IO NC system. The Workflow as well as the Roles and Responsibilities of each stakeholder are specified in a generic way.

Approval Process			
	Name	Action	Affiliation
Author	Neagu S.	19 Mar 2021:signed	IO/DG/SQD/QMD
Co-Authors			
Reviewers	Calpena S. Crowther D. Drummond M. Elbez-Uzan J. Ilves J. * Jung C. Y. Kirnev G. Lamotte P. Meignan V. Merola M. Miele P. Mokaria P. Pang B. Salamon B. Sato K. Yoon B. Zhang B. Zhao Z.	09 Apr 2021:recommended 12 Apr 2021:recommended 06 Apr 2021:recommended 08 Apr 2021:reviewed 12 Apr 2021:recommended 06 Apr 2021:recommended 29 Mar 2021:recommended 02 Apr 2021:recommended 13 Apr 2021:reviewed 25 Mar 2021:recommended 30 Mar 2021:recommended 31 Mar 2021:recommended 30 Mar 2021:recommended 08 Apr 2021:recommended 26 Mar 2021:recommended 24 Mar 2021:recommended 31 Mar 2021:recommended 19 Mar 2021:recommended	IO/DG/SQD IO/DG/CORP/FPD/PCD/ESOC IO/DG/SQD/EPNS F4E (EU) IO/DG/SQD/QMD Russian Research Centre "Kurchatov ... IO/DG/CORP/FPD IO/DG/ENGN/EDD IO/DG/CORP/PCO/ECPC IN DA (Supplier & DA) (IN) IO/DG/ENGN/CIO/CMD/DCC QST (JP) Chinese Domestic Agency (CN) IO/DG/SQD/QMD
Approver	Tada E.	13 Apr 2021:approved	IO/DG/CORP
Document Security: Internal Use RO: Khomutnikov Aleksei			
Read Access	LG: SQD Managers, GG: MAC Members and Experts, LG: Quality Control Group, AD: ITER, AD: External Collaborators, AD: IO_Director-General, AD: External Management Advisory Board, AD: OBS - Quality Management Division (QMD) - EXT, AD: OBS - Quality Management Division (QMD), AD: Auditors, AD: ITER Mana...		

<i>Change Log</i>			
Procedure for Management of Nonconformities (22F53X)			
<i>Version</i>	<i>Latest Status</i>	<i>Issue Date</i>	<i>Description of Change</i>
v1.0	In Work	25 Feb 2005	
v2.0	In Work	14 Sep 2005	
v3.0	In Work	14 Dec 2005	
v4.0	In Work	28 Feb 2006	
v4.1	Signed	10 Apr 2008	
v4.2	Signed	10 Apr 2008	
v4.3	Signed	11 Apr 2008	
v4.4	Approved	11 Apr 2008	
v5.0	In Work	18 Jun 2012	Definitions of Deviation and Specified Requirement clarified and immediate notification and agreement of classification of non-conformances introduced
v5.1	Approved	18 Jun 2012	Minor editorial change to contents
v6.0	Approved	02 Apr 2013	- modification of the title - add the following steps in the process for non-conformities: - root cause analysis - corrective action (if needed) - closure of NCR
v6.1	Approved	25 Jun 2013	Modifications according to approved MQP Doc Request G23MB4: - Changes to allow verbal agreement on remedial actions when the non-conformance does not impact on an external system - Minor NCR: the section 1, 2.1 and 2.2 need to be filled and sent to IO
v6.2	Approved	13 Mar 2015	Changes according to MQP doc Request - QWRRS2: - Addition of an explanatory footnote for PIC and PIA - Addition of PIA with PIC - Addition of list of internal NCRs to be sent to IO upon request of QARO
v7.0	Approved	18 Aug 2017	Update according to MQP doc request VBFECU (the summary of pre-reviews: MQPWG, SQA WG, SD, Construction Teams... can be found in the MQP doc request VBFECU). The changes consists in clarification, simplification by making the document generic (thus applicable to all phases; not only to Manufacturing but also to Construction), and rework of the document according to the MQP template 438T76: - Process NC introduced (not product NC as previously understood); - Simplification of number of documents (starting situation was 6 documents level2): 22F53X is now the Level 2 MQP for Nonconformity management, e.g. merging RGF2R7 (PT), dealing with both external IO NC and internal IO NC. - The workflow and roles rendered generic (e.g. notion of DIRO now extended to 'interaction RO', so that it can encompass Construction Teams). - Clarified list of criteria (Baseline, Performance,...) to guide in the categorization of NC (major / minor), still keeping the same criteria regarding Regulatory Requirements, Safety, Environmental impact. - The requirement of paragraph 2.9 of revised QAP version 8.5, and GIN007 (General Instruction Note from DG), are propagated: tracking of NC closure; re-enforcement of tracking mechanism of actions until implementation. - KPI of the process and escalation process (in case of dispute) are introduced.
v7.1	Approved	11 May 2018	As per MQP doc Request - WK69F2 Includes Module H needs
v8.0	Revision Required	10 May 2019	as per approved MQP doc Request - XYLYX5: - requirements regarding Counterfeit, Fraudulent, and Suspect Items (CFSI)

			as per Safety Division Action plan (definition CFSI included, clear requirement for SD involvement and responsibilities). - clarify the IO NC approval level (process owner / DH) as per NCR database application - reference of JIRA CAT system to be applied for action follow-up - clarification related to minimum time - frame from NCR detection until NCR recording (maximum two weeks is allowed). - clarifications regarding intermediate / conditional release of NCR that requires further long term actions (further actions and instruction to be recorded in release note).
v8.1	Signed	14 Jun 2019	Revision to implement reviewer comments from previous version. List of changes: - add reference - XKUKAX - add DAs responsibilities (as per NCR database application) - add clarifications regarding baseline levels (see chapter 5.1 and annex 2) - add further clarifications for NCR conditional release. - add annex 2 - Baseline level map as per [11] - add clarifications on appendix 1 - NC form
v8.2	Approved	17 Jun 2019	Revision - Technical IDM issue. Revision as per MQP doc Request - XYLYX5 & to implement reviewer comments from previous version. List of changes: - add reference - XKUKAX - add DAs responsibilities (as per NCR database application) - add clarifications regarding baseline levels (see chapter 5.1 and annex 2) - add further clarifications for NCR conditional release. - add annex 2 - Baseline level map as per [11] - add clarifications on appendix 1 - NC form
v9.0	In Work	19 Mar 2021	- Chapter 3.1 – arrange definition – alphabetic order - Chapter 3.1 – add the following definitions: - o Causal Analysis Tree - o Contractor - o Inter-Organization Non-Conformity (I-NC): - o IO NC system (add note for clarification NC database scope) - o PE Group - o Scrap (remedial action) - o Root Cause Analysis (RCA) - o Service - o Service provider - Chapter 3.2 add the following abbreviations: - o CAT; I-NC, PBS, PROR, SCG - Chapter 4.1 add the following references - o [31] How to – Long Aging NCRs management 3CZWDX - o [32] Risk and Opportunity Management Procedure 22F4LE - o [33] Management review procedure 3L7SWX - o [34] Lessons Learned meeting Procedure DV4UUH - Add note “The procedures are applicable to the DAs, only if they are listed in the Multi Party Amendment (MPA).” - Chapter 5.1, 5.2, 5.3 and 5.4 - o Change the structure of procedure to reflect the NCR stages - o For NCR categorization ITER_D_4HCC3W - HOW TO - NCR Categorization was added - o Add RCA categories and Causal Analysis Tree (CAT) - o Add mandatory requirements to defined expected due dates for decided remedial actions - o Add mandatory requirements to defined expected due dates for NCR closure

			- o Add specific section for Inter-Organizational Non-Conformity (I-NC) - o Add requirements for application of fast NCR closure – applicable only for minor NCR - o Add specific section for Conditional Release of NC. - o Add clarification for RCA methodology - ITER_D_2X4E9A - Root Cause Analysis Leaflet - o Add clarification for NCR closure - o Add interaction with the risk and opportunity process. - Chapter 5.5 – changes to introduce specific requirements for Module H and H1. - Add chapter 5.7 – Internal NC of Performers - Chapter 7 – change the responsibilities for process owner and DH – for IO NCRs - Chapter 9.3 – add requirements for “Nonconformities survey process for PIC and PIA”
v9.1	Approved	19 Mar 2021	Technical issue

Table of Contents

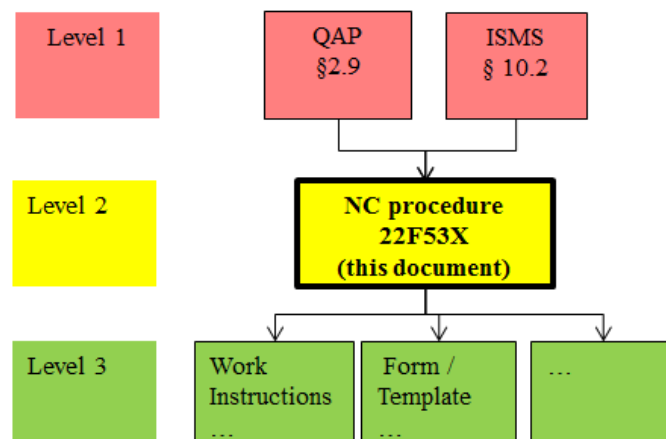
1	PURPOSE	2
2	SCOPE.....	2
2.1	OUT OF SCOPE.....	2
3	DEFINITIONS AND ACRONYMS	2
3.1	DEFINITIONS	2
3.2	ACRONYMS	5
4	APPLICABLE AND REFERENCE DOCUMENTS.....	6
4.1	APPLICABLE DOCUMENTS.....	6
4.2	REFERENCE DOCUMENTS.....	7
5	BASIC PRINCIPLES.....	7
5.1	GENERAL PRINCIPLES FOR NC MANAGEMENT	7
5.2	NCR INITIATION – 1A	8
5.3	ASSESSMENT OF NONCONFORMITY – STAGE 1B	9
5.4	NCR CLOSURE – STAGE 2	11
5.5	PE/NPE ASSESSMENT	12
5.6	CASE OF NC RELATED TO CFSI.....	13
6.	WORKFLOW	15
7.	RESPONSIBILITIES	16
8.	RECORDS/OUTPUTS	18
9.	LINK WITH OTHER PROCESSES	18
9.1.	LINK WITH OTHER ‘QUALITY ASSURANCE’ PROCESSES (QA AUDIT, CAR)18	
9.2.	LINK WITH ‘PROCUREMENT’	18
9.3.	LINK WITH ‘NUCLEAR SAFETY’	19
9.4.	LINK WITH ‘CONFIGURATION MANAGEMENT’ PROCESS	19
9.5.	LINK WITH ‘DOCUMENTS AND RECORDS’	19
9.6.	LINK WITH “PE/NPE CONFORMITY ASSESSMENT”	20
10.	DISPUTE AND RESOLUTION.....	20
11.	KPI	20
APPENDIX 1: LIST OF RELATED INFORMATION / DATA TO BE PROVIDED IN NC SYSTEM TEMPLATE		21
APPENDIX 2 – TECHNICAL BASELINES OVERVIEW LEVELS AS PER [11] – SEE ITER BASELINE DIAGRAM.....		23
APPENDIX 3 – CAUSAL ANALYSIS TREE FOR ROOT CAUSE ANALYSIS (RCA).....		24

1 Purpose

The purpose of this document is to specify the Nonconformity Management process, hereinafter NC from the Initiation to the Closure in the IO NC system. The Workflow as well as the Roles and Responsibilities of each stakeholder are specified in a generic way.

2 Scope

This MQP Level 2 Procedure belongs to the Process ‘Quality Assurance’ and propagates the requirements of the chapter 2.9 of the Quality Assurance Program (QAP) [5], and of the chapter 10.2 of the Integrated Safety Management System Manual (ISMS) [6]. Hierarchy of MQP documentation is illustrated below:



This procedure shall be followed for the management of Nonconformities detected during the all ITER project phases (from the design until operation/maintenance).

- for both types of NCs: Product NC and Process NC,
- by both internal and external performers (IO/ DAs/ suppliers / contractors).

2.1 Out of Scope

- Management of Deviation Request.
- Cost and schedule issues. To be treated as per contractual requirements.
- The management of Internal Nonconformities ¹ of external Performers is not covered by this procedure.
 - However, external Performers shall make lists of their Internal Nonconformities available to IO for information, on request of IO.
- NC of Quality Audit (see link with others processes in **section 9**)

3 Definitions and acronyms

3.1 Definitions

Action assignee: An all-inclusive term to designate any person assigned to perform an action in the course of the NC treatment. This person can be from any organization.

Authorized Body/Authorized Notified Body: Organisation authorized by a member state to carry out conformity assessment of pressure equipment and /or nuclear pressure equipment.

Baseline documents (level 0, 1, 2 and 3) – to be used for NC categorization – definition as per [11].

¹ Nonconformities according to the QMS of the external Performers

The ITER baseline is the set of all configuration items with all of its applicable documents approved at one of the project's key milestones that serve as a reference for activities throughout the lifecycle of a product. The scope of a baseline shall be unique and not overlapping with any other.

Causal Analysis Tree: The Causal Analysis Tree is shown in Appendix 3 ("B"-Level) of the procedure. The Causal Analysis Tree is a result of a benchmarking study of industry causal analysis systems. The lowest level of the Causal Analysis Tree is typically referred to as the "B" Level. The Causal Analysis Tree allows for a tailored approach to developing corrective actions

Corrective vs preventive/risk-based actions²

- **Corrective action:** action to eliminate the cause of Nonconformity.
- **Preventive/risk-based action:** an all-inclusive term to refer to an action to eliminate the cause of a potential nonconformity

Contractor: legal entity/ organization who has entered into a contract with the IO.

Counterfeit, Fraudulent, and Suspect Items (CFSI)

A counterfeit item is a copy or substitute without legal right or authority to do so or one whose material, performance, or characteristics are knowingly misrepresented by the vendor, supplier, distributor, or manufacturer.

A fraudulent item that items which is intentionally misrepresented to be something they are not.

A suspect item is one in which there is an indication by visual inspection, testing, or other information that it may not conform to established industry-accepted specifications or national/international standards.

Deviation Request, DR (out of Scope)

Request for deviation from a specified requirement in a formal agreement (e.g. signed contract, signed Procurement Arrangements...).

DA RO

- DA staff member nominated as responsible for the coordination of NC process within DA and ensuring continuous interfaces with IO and performers (initiation and closure of the NC).
- For the NCR related to PA implementation, the IO NC system (NCR database) shall be used. For NCRs where the NC ownership will be under DA responsibility, the DA RO will apply DA specific NCR procedure.

Inter-Organization Non-Conformity (I-NC):

² Clarification on the term 'preventive' in this document: depending on Standards, various terminologies exist:

Definitions ISO 9000 v2015 (QMS - Fundamentals & vocabulary)	Concept of preventive action in ISO9001 v2015 (QMS - Requirements):	Terminology INB order [1]	Terminology IAEA GSR part 2 / 2016
3.12.1 preventive action action to eliminate the cause of a potential nonconformity or other potential undesirable situation ... Note: Preventive action is taken to prevent occurrence whereas <i>corrective</i> action is taken to prevent recurrence.	0.3.3 Risk-based thinking The concept of risk-based thinking has been implicit in previous editions of ISO 9001, including for example carrying out preventive action to eliminate potential nonconformities ... One of the key purposes of a quality management system is to act as a preventive tool. Consequently, ISO 9001 v2015 does not have a separate clause or sub clause on preventive action.	Art. 2.6.3. – I. – The operator ensures discrepancies are managed within a time-frame adapted to the issues concerned, in particular by ... defining the appropriate remedial, preventive and corrective actions	6.3. The causes of non-conformances of processes ... shall be evaluated and any consequences shall be managed and shall be mitigated ... The status and effectiveness of all corrective actions and preventive actions taken shall be monitored and shall be reported to the management at an appropriate level in the organization.

Nonconformity with multiple interfaces between different entities DAs / IO and suppliers. A non-conformity that may be resolved more efficiently or in the best interests of the ITER Project by a party (DA or IO) other than by the Sending DA or its contractors. It applies in situations when a quality issue is identified late in the item's manufacturing process when there is a time criticality associated with the onward availability of this item, causing consequential impacts on later work.

Initiator of a NC:

- Entity or person who detect the Nonconformity and triggers its' registration. Mainly the performer but can be any stakeholder of the ITER project (e.g. IO-CT, IO-PT, DA, ASN, (A)NB staff members, etc.).

IO/ DA Specified Requirement:

- Specified requirements by IO/ DA including:
 - Technical and Quality requirements
 - Regulatory requirements.

IO NC Owner, hereafter IO-RO:

- IO staff member nominated as responsible for the coordination and closure of the NC, in the IO NC system (NCR database). Depending on NC scope the IO-RO is :
 - for Product NC, TRO (manufacturing phase) or CRO (construction phase).
 - for Process NC, the IO DH of affected entity.

IO-Interactions RO

- An all-inclusive term to designate a RO who is managing the project / contract affected by the original NC and related interactions with other systems (e.g. DIRO or RO in Construction Teams...).

IO NC system:

- An all-inclusive term used to refer to the agreed system for tracking and recording NCs until closure in IO. Either IO NCR Database (DB) or through IDM system (for specific cases – see the **note**).

Note: IDM maybe used only for specific cases when NC database does not provide necessary configurations, ensuring flexibility for recording of such specific NCR (e.g. cases when performers refuse or are not available to apply NCR DB, etc.). The use of IDM instead of NCR database shall be agreed with IO QARO in advance (by email). After NCR approval in IDM, QMD shall ensure the transfer (link) of such NCR from IDM to NCR database (NCR legacy) considering the graded approach established by QMD.

Long-term actions – Actions (remedial/ corrective actions) that requires more than one month for implementation and strict follow-up of responsible and due dates.

Manufacturer Means any organization or legal person who manufactures a product or has a product designed or manufactured, and markets that product under his name or trademark.

Nonconformity, herein NC

- Non-fulfilment of a requirement.
- Product or Process, which does not fulfil or fail in meeting IO / DA, specified requirements.

NC report

- Nonconformity Report, i.e. the record of each Nonconformity (NC); sometimes referred as NCR.

Performer

- An all-inclusive term used to cover both IO internal and external organizations, such as IO-CT, IO-PT, Domestic Agencies, Suppliers, Manufacturers and Contractors... who provide products (SSC...), works or services to ITER project.

PE Group

The PE Group is responsible for all matters related to the proper and efficient implementation of Pressure Equipment and Nuclear Pressure Equipment regulations within the whole ITER Project – part of EPNS.

Product NC: When the requirement related to the characteristic of an item, component or work is not fulfilled. As an example, failure in meeting a specified tolerance of a component.

Process NC: When the MQP procedural requirement are not fulfilled is relative to the specified way of working. As examples, failure in the propagation of requirements in the Supply Chain; failure in the execution of Design process, failure in the notification of a contractual hold point.

The Process NC related to IO processes, will be treated by IO as internal NC in accordance with detailed IO internal working instructions.

The Process NC related to performers processes, will be treated as Internal NC of performers in accordance their internal procedures – **see chapter 5.7 conditions**

Remedial action

- Action to eliminate a detected Nonconformity
 - **Use as-is:** the item deviates from requirements but is declared fit for the intended use.
 - **Rework:** compliance with the original requirements can be restored.
 - **Repair:** fitness for the intended use can be restored although the repaired item may not conform to the original requirements.
 - **Reject:** the item is not fit for the intended use.
 - **Scrap:** the item is not fit for the intended use (cannot be restored) and it cannot be used for different other scope.
 - **Other**

For process NC, the remedial actions will be specifically defined as per NC evaluation and RCA.

Root Cause Analysis (RCA)

Set of problem solving techniques targeted at identifying the actual root cause or the reason that caused the problem. The need for RCA stems from the fact that the elimination of the symptoms of the problems is not alone sufficient to address the problem, it has to be addressed at the cause level.

Service - output of an organization (service provider) with at least one activity necessarily performed between the organization and the IO. The dominant elements of a service are generally intangible.

Service often involves activities at the interface between IO (responsible for establishing the requirements) and service provider, as well as upon delivery of the service and can involve a continuing relationship.

Service provider – organization that provides a service. In a contractual situation, a service provider is sometimes called contractor.

3.2 Acronyms

Complementary or as quoted in [23] ITER abbreviations:

ASN	French Nuclear Safety Authority (from French: Autorité de Sûreté Nucléaire)
(A)NB	(Authorized) Notified Body
CAR	Corrective Action Request
CAT	Causal Analysis Tree – see annex 3
CCB	Configuration Control Board
CFSI	Counterfeit, Fraudulent, and Suspect Items
CRO	Contract Responsible Officer

DA	Domestic Agency
DH	Division Head
DR	Deviation Request
EPNS	Environmental Protection & Nuclear Safety Division
FR	Functional Reference
I-NC	Inter-Organization Non-Conformity
IO	ITER Organization (sometimes referred to as ITER)
IO-RO	IO Responsible Officer of the work package affected by the NC
IO-DIRO	IO Design Integration Responsible Officer
IO-QARO	IO Quality Assurance RO
IO-SRO	IO Safety Responsible officer
IO-CT	ITER Organization Central Team
IO-PT	Project Team established in accordance with 4.ii of [QYTZEP]
IDM	ITER Document Management(System)
ISMS	Integrated Safety Management System Manual
KPI	Key Performance Indicator
MQP	Management Quality Program
MIP/ITP	Manufacturing Inspection Plan / Inspection and Testing Plan
NC	Nonconformity
NCR	Nonconformity Report
NSI	Nuclear Safety Inspection
PA	Procurement Arrangement
PBS	Plant Breakdown Structure
PCR	Project Change Request
PIC	Protection Important Component, as defined in [24] 0
PIA	Protection Important Activities, as defined in [24]
PIM	Project Issue Management
PE/NPE	Pressure Equipment (PE) in the scope of [2] Nuclear Pressure Equipment (NPE) in the scope of [4]
PE Group	Pressurized Equipments Group – part of EPNS
PNI	Part Number of ITER
PROR	Project Risk and Opportunity Register
QAP	Quality Assurance Program
QMD	Quality Management Division
QMS	Quality Management System
RCA	Root Cause Analysis
RRF	Review of Regulatory Files
RO	Responsible Officer
SSC	System, Structure and Component
SCG	Safety Control Group
SOA	Sign-Off Authority
SR	Safety Related
SQD	Safety and Quality Department
TRO	Technical Responsible Officer

4 Applicable and Reference Documents

4.1 Applicable documents

Regulations	[1]	Order dated 7 February 2012 relating to the general technical regulations applicable to INB - EN	7M2YKF
	[2]	Pressure Equipment directive 2014/68/UE [French version]	RZ6PAK [RZ5PGG]
	[3]	Environmental code mainly art L557 and art R557 – Décret n° 2015-799 du 1er juillet 2015 relatif aux produits et équipements à risques - EN	U5TKD4
	[4]	ESPN Order dated 30 December 2015 modified – Arrêté du 30 décembre 2015 relatif aux équipements sous pression nucléaires - [EN]	SMP384
MQP Level 1	[5]	Level 1 MQP – ITER Quality Assurance Program (QAP)	22K4QX
	[6]	Level 1 MQP - ITER Integrated Safety, Environment and Security Management System Manual (ISMS)	4HCWJU
	[7]	ITER Policy on Safety, Security and Environment Protection Management	43UJN7
Interacting processes – MQP	[8]	Level 2 MQP - Document & Records process - Sign-Off Authority for Project Documents	2EXFXU
	[9]	Level 2 MQP – Nuclear Safety process - Procedure for the Safety Review of Regulatory Files	48VD6T
	[10]	Level 2 MQP – Nuclear Safety process - Organization of nuclear safety inspections in ITER Organization and its supplier chain	CW8EL3
	[11]	ITER Baseline diagram	2XWZEK
	[12]	Nonconformity and corrective actions Survey Process for PIC and PIA in Application of Articles 2.6.3, 2.7.1 and 2.7.3 of the INB Order	HDAWCU
	[13]	Level 3 MQP – Configuration Management process – Project Issue Management	SSU96T
	[14]	Level 2 MQP – Inspection and Testing process – Requirements for Producing an Inspection Plan	22MDZD
	[15]	ITER Procurement Quality Requirements	22MFG4
	[16]	Requirements for Producing a Contractors Release Note	22F52F
	[17]	Release Note Template	QVEKNQ
	[18]	Working Instruction for Mechanical Completion Dossier Preparation	UYUSEE
GIN	[19]	GIN 007 - Closure of Non-Conformance Reports	UKG3W8
<i>Note: The procedures are applicable to the DAs, only if they are listed in the Multi Party Amendment (MPA).</i>			

4.2 Reference documents

[20]	Quality Management System Audits	2DQTA8
[21]	ITER Corrective Action Procedure (CAR)	9QELY2
[22]	DA / Supplier / Sub-contractor QA Non-conformance Report Template	A6HRLB
[23]	ITER abbreviations	2MU6W5
[24]	Nuclear safety common definitions	RLZXMV
[25]	IO QA Non-conformance Report Template	2MVY2Z
[26]	Project Change Procedure	22F4E5
[27]	Guideline for identification (Symptoms) of Counterfeit,	

	Fraudulent XKUKAX	and	Suspect	Items	(CFSI)
[28]	Procedure for Implementation of the Inter-Organizational Non-Conformity Resolution Process				YVPWYR
[29]	ITER Project Management Plan (PMP)				2NCR3F
[30]	Procedure for management of Deviation Request				2LZJHB
[31]	How to – Long Aging NCRs management				3CZWDX
[32]	Risk and Opportunity Management Procedure				22F4LE
[33]	Management review procedure				3L7SWX
[34]	Lessons Learned meeting Procedure				DV4UUH

5 Basic principles

5.1 General principles for NC management

- The main steps for the methodology for NC management, are as follows:
 - The organisation, where the NC is detected, shall immediately stop works related to the nonconforming product /service and to inform IO.
 - Immediate actions to segregate (labelling and/or physical separation of NC shall be applied) the nonconforming item / work and to ensure safety.
 - Description of the nonconformity - NC report shall be immediately registered in NC system.
 - Agreement and implementation of remedial actions to eliminate the Nonconformity. The remedial action can be implemented only after IO formal agreement.
 - Root cause determination through RCA (Root Cause Analysis) using Causal Analysis Tree and decision on corrective & preventive/risk-based actions
 - Follow-up of actions from their initiation until their implementation
 - Verification of the effectiveness of actions.
 - NCR closure - NCR shall be handled and closed with the priority.

5.2 NCR initiation – 1a

During NC initiation stage – 1a, the following points need to be addressed (but not limited):

- Recording the NCR (Description of the problem)
- NCR categorization (major / minor)
- Preliminary proposal of remedial actions need to be established (if the initiator can provide this information at this stage).

Recording of NCR

Once NCR is detected, the initiator is recording the NC in the IO NCR database (status “Submit”) or equivalent electronic system (e.g. IDM for internal IO NCRs (status “Sign”) recognised by IO.

NC report shall be submitted within maxim 5 working days in the NC system to initiate the NC process (trigger the NCR review / approval cycle). In case of dispute between stakeholders, maximum two weeks from the NC detection time may be allowed with IO agreement only.

For management / use of IO NCR database, stakeholders shall apply detailed instructions:

- [ITER_D_SM2JWP - NCR Database - Introduction & How to for IO-DA personnel](#)
- [ITER_D_SY6RQ5 - NCR Database - Introduction & How to for Suppliers and Contractors](#)

Immediate actions shall be taken to segregate (*labelling and/ or physical separation of NC shall be applied*) the nonconforming item / work and to ensure safety.

After the NCR is submitted in the NC system, the review and approval cycle will be launched and will allow to the performer and all effected stakeholders to provide their feedback.

In case during the review / approval the NCR is rejected, then the NC owner (approver) is immediately informed and will have the responsibility to restart / re-submit the NCR only after all the conditions are agreed and applied. In case of disputes, the NC owner shall ensure further escalation as per - **section 10** of present procedure.

NCR categorization

The preliminary categorisation of NCR shall be done at the initiation stage with the involvement IO RO (confirm) and IO QARO in accordance with the following criteria:

- In ITER project, the way to implement this graded approach for NC management is to categorize NCs either as ‘Major’ NC or as ‘Minor’ NC depending on the impact of the NC to the safety, quality or performance.
- The following table provides guidelines to establish the category of the NCR. The final categorization shall be agreed between:
 - NC initiator (propose the NC categorization),
 - Performer (propose the NC categorization if initiator),
 - DAs TRO (provide support and agreement for NC categorization) in case of PAs implementation and
 - IO-RO with support of IO QARO (final confirmation of NC categorization).

Major NC	Safety / Regulation	- Nonconformity with a IO specified requirement affecting Regulatory Requirements, Safety, Environmental impact
	Baseline*	- Nonconformity with an impact on a Baseline document Level 0 / 1 / 2
	Interactions	- Nonconformity with interaction with other PBS, Construction and/or other Process
	Impact on Performance	- Implication on Functional performance
	Repetitive NC	- More than 2 similar NCRs can trigger one major NC to investigate root cause of recurrence.
Minor NC	Safety / Regulation	- Nonconformity with a specified IO requirement not affecting Regulatory Requirements, Safety, Environmental impact
	Baseline*	- Nonconformity with an impact on a Baseline document Level 3
	Interaction	- Nonconformity with no interaction with other PBS, Construction and/or other Process
	Impact on Performance	- Implication on layout (within the same space reservation of concerned system/ PBS)
	Nonconformity not falling under definition of Major NC.	

*Baseline document levels are defined as per IO procedures [11] and [29].

The detailed requirements /clarifications regarding NCR categorization are described in the [ITER_D_4HCC3W - HOW TO - NCR Categorization](#).

During the NC initiation stage, performer shall propose preliminary remedial actions (if the initiator can provide this information at this stage) and need to be recorded in NC system for IO acceptance.

5.3 Assessment of Nonconformity – Stage 1b

During NC evaluation stage – 1b, the following points need to be addressed (but not limited):

- Final remedial actions need to be recorded in NC system and agreed with NC owner.
- Preliminary Root Cause Analysis (RCA) need to be applied and propose corrective actions / RCA category need to be established and recorded in NC System (when required)

During the NCR assessment stage, the remedial actions shall be clearly defined and agree by IO-RO.

For all the decided remedial actions the expected due dates and responsible for closure need to be established and recorded in NC system – Sage 1b.

RCA categorization with Causal Analysis Tree (CAT) evaluation shall be applied for all NCRs.

For Minor NCR, the application of RCA remains under performer internal responsibility and does not require IO acceptance. This approach regarding minor NCR evaluation does not release the performer from his responsibility to ensure correct evaluation of NCR, establishing the NCR Causes and corrective actions application.

The root-causes of nonconformities are categorized based on Causal Analysis Tree by the type of failure/problems as following:

RCA category/ level	Description of RCA category by type of failure
A1	Design/ Engineering problem
A2	Equipment/ Material problem
A3	Human Performance problem
A4	Management (procedure/ process/ method) problem
A5	Communications problem
A6	Training Deficiency
A7	Other Problem

Each RCA categories/ levels (A) are also divided in sub-categories/ levels (B) as described in Annex 3 of present procedure. The sub-categories/ levels (B) – see annex 3, need to be recorded in the RCA report only.

The RCA category – level A, shall be recorded by performer in the NC system in the “Preliminary Analysis of Causes” section and confirmed by IO-RO (NC owner).

In IO and DA, the NC owner is primarily the RO of the item or work being affected by the NC.

- In case of NC involving several Performers, an owner in IO (or DA – for the cases when the NC does not have impact on IO requirements) shall be established with the responsibility to coordinate all actions between parties and supervise the overall action plan.

Two options are possible for NC treatment:

- A unique NC is opened covering all aspects and Performers;
- Several NCs are opened for each Performer.

If the NC owner face issues in finding agreement between parties, or if there is no agreement to find an NC owner, issue will be escalated according to **section 10** of present procedure.

For the cases when the DA is NC owner (NC with no impact on IO requirements), the DA shall apply their own specific NCR procedure accepted by IO.

For most of the cases the performer is also assigned for NCR closure. For specific cases when responsible for NC closure is other entity than performer, during the NC evaluation stage the NC owner (IO-RO / DA- RO), shall confirm (indicate) who is responsible entity for NCR closure.

Also, during the NC evaluation stage, after identification of NCR impact analyse, the NCR has to be linked (IDM, PLM etc.) to the applicable document (drawings, specification, procedure, etc.) that are affected by the NCR and requires future update. This task is under NC owner responsibility.

For specific situations, stage 1a (NC initiation) and stage 1b (NC evaluation) can be merged into one stage (1b) - if the NC initiator have all the necessary information: description of NC, Categorization, establish remedial actions, NC evaluation, Preliminary RCA, Corrective actions and categories.

Inter-Organizational Non-Conformity (I-NC)

The I-NC is a non-conformity applied in situations when a quality issue is identified late in the items manufacturing process when there is a time criticality associated with the onward availability of this item, causing consequential impacts on later work.

The NC identification is the trigger event of the I-NC but the close out of each process does not depend on the same elements.

The NCR should be kept open for technical corrective and remedial actions whereas the I-NC is kept open for financial actions as per applicable procedure [28]. The NCR can be closed even if the I-NC is not closed and vice versa.

When an I-NC is detected, the NCR title should indicate the mark “I-NC” to raise the attention of stakeholders and initiate application of I-NC mechanism. The mechanism and details for treatment of I-NC is described in the [28].

5.4 NCR closure – stage 2

When required (see note 1), a detailed RCA shall be performed with conclusions whether or not launching corrective actions, and should consider as appropriate any preventive/risk-based actions.

Note 1: The RCA is required to be applied for all NCs in accordance with the following criteria:

- For major NCR's, the RCA need to be accepted by IO and shall be mandatory recorded in NC system.
- For minor NCR's, the RCA does not require IO acceptance and shall be under performer responsibility only. For specific cases decided between performer and NC owner (IO-RO), the RCA may be submitted to IO for acceptance and recorded in NC system.

For all the corrective actions indicated in the RCA, the expected due dates and responsible for closure need to be established and recorded in the NC system (when Preliminary RCA is finalized -1b stage).

For complex RCA, the performer (responsible for NC closure) shall arrange specific RCA meetings and perform a detailed RCA. The RCA results and conclusions, together with the decided corrective actions shall be recorded in RCA report with the following information: RCA team members, RCA method, chronology of the events, causes of NC, corrective actions and risks required to eliminate and prevent the NC, etc.

For Root Cause Analysis (RCA) application the following guidance may be used [ITER_D_2X4E9A - Root Cause Analysis Leaflet](#) by the stakeholders.

The NCRs can be closed only after the following conditions are met:

- **For minor NCRs:**
 - all remedial actions are closed (respecting the expected due dates – as recorded in the NCR stage 1) and evidences for remedial actions closure are recorded (attached to NCR for closure stage) in IO NC system.
 - For minor NCRs, the RCA application together with corrective actions implementation are under performer responsibility only and does not require IO acceptance.
 - in case the decided remedial actions (ex: “reject”, “scrap”) will not remain part of (will not affect) the final product or activity that will be delivered to IO and the related corrective actions (if necessary) will be implemented internally by performers without affecting IO products and activities, the NC can be closed immediately – fast NCR closure**. For such cases, the NC owner shall agree on fast NCR closure mode.

****note:** Fast NCR closure is applicable for minor NCRs where the remedial actions (“reject” or “scrap”) will not affect the final products / activities that will be delivered to IO. Fast NCR closure means, immediate NCR closure after initial stage of NCR is reviewed and approved – does not require a new review / approval cycle for NCR closure by all stakeholders.

- **For Major NCRs:**
 - all remedial actions are closed (respecting the expected due dates – as recorded in the NCR stage 1) and the evidences for remedial actions closure are recorded (attached to NCR for closure stage) in IO NCR database (or IDM).
 - all corrective actions (CA) decided as per RCA are closed (respecting the expected due dates – as recorded in RCA) and the evidences for CA closure are recorded in IO NC System (attached to NCR for closure stage).

The final closure of NC is confirmed if all related actions are implemented to guarantee the IO requirements of the item or work at the handover to IO.

For NCR closure, the performer (responsible for NCR closure) issues the update of NCR (NC report) in the IO NC system, to ensure NCR is reviewed & accepted /approved by all relevant stakeholders.

As a basic principle, the delivery of the items shall be released only if all the related NCR’s are closed.

The IO NC system record the actions (remedial/corrective actions) agreed with Performers and also the internal actions in IO. If it is decided to follow some long-term actions (remedial/ corrective actions) in a separate system (JIRA CAT system or equivalent electronic system), traceability of the actions and tracking system shall be demonstrated to monitor the progress. The NCR shall not be closed if the related remedial actions / corrective actions are still open (see previous paragraphs for NC closure conditions.)

If during the NCR treatment, the risk and opportunities are identified then the IO-RO shall record the risk and opportunity in IO register (PROR) as per procedure [32].

Conditional Release of NC.

For exceptional cases, intermediate/ conditional release of the NCRs can be accepted only after agreement between IO (NC owner) and DA’s / performers.

For such cases when conditional release of the NC is agreed to allow the shipment of components, tracking and checking of remaining points/ actions is required, until the final closure of the NC and handover.

To ensure proper follow-up of conditional release of NCRs, the performer shall maintain the NCR open until all the decided remaining conditions / actions are closed. The continuous follow-up of NCRs status will ensure on the same time the follow-up of such conditionally released NCRs.

For such cases when conditional release of NC is applied, clear further instructions/ actions shall be also indicated in the NCR and in the final delivery documentation (section 6 of [17] - Release Note template – [QVEKNQ](#) or section 12 – Punch list of Mechanical Completion Dossier prepared as per [18] - [UYUSEE](#)) to be taken into account on the next phases of the project.

The performer shall record the NC conditional release in NC system and NC owner will communicate this information to the corresponding IO team (IO construction team, PT, PBS team etc.) if any impact on the next phases of the project.

5.5 PE/NPE Assessment

This section is useable only when IO is acting as PE/NPE manufacturer. This section explains the process to sort out the nonconformity detected during design and manufacture of pressure equipment or nuclear pressure equipment.

Nonconformity shall be close out following relevant paragraph 5.3.

A nonconformity concerning a PE/NPE or Implementation plan for design & manufacture of PE/NPE (VE2DSP) is considered as properly closed by IO if the impact on the other past, current and future productions is performed.

5.5.1 Nonconformity related to Equipment manufactured by IO in the scope of Module H/H1

5.5.1.1 Process Nonconformity

IO describes and presents to ANB³ the solutions it intends to adopt to remedy the process nonconformity related to the application of Implementation plan for design & manufacture of PE/NPE – VE2DSP and shall obtain ANB validation⁴ before they are implemented.

5.5.1.2 Product NCR

Product Non-Conformances are classified as Major or Minor according to the criteria defined in chapter 5.2 above.

IO will describe the solutions it intends to adopt to remedy the non-conformances and will keep the related records available for ANB consultation.

5.5.2 Nonconformity related to Equipment manufactured by IO out of the scope of Module H/H1

5.5.2.1 Major Product Nonconformity

Only major product NCR affecting regulations [1], [2], [3] & [4] shall be sent to ANB.

IO describes and presents to ANB³ the solutions it intends to adopt to remedy the major product NCR and shall obtain ANB validation⁴ before they are implemented.

As soon as the NCR is uploaded in NCR database, PE/NPE expert shall send to ANB:

- the NC and all necessary information (report, drawing, picture...),
- remedial actions proposal : Whenever the supplier or subcontractor is able to repair in accordance with the PA documentation and/or selected code, this will be the preferred remedial action,
- Root-cause-Analysis.

If the repair is not following the PA/ contract documentation, contract and/or selected code, IO needs to evaluate if this repair has an impact on an essential safety requirement of [1], [2], [3] or [4] and if the hazards and risks analysis should be updated and submitted to ANB for approval.

To implement the remedial action(s), a revision of original MIP /ITP or new MIP/ITP will be prepared to include the new operations and the needed intervention points from all the parties. IO/ANB could add new control points (Hold points, witness points, reports and notification points).

5.5.2.2 Minor Product Nonconformity

The supplier or subcontractor is able to repair in accordance with the PA/ Contract documentation or existing repair procedure(s) approved by IO and accepted by ANB.

Minor NC and all evidences or reports are kept by IO in NCR database and are available to ANB on their demand (periodic meeting, ANB visit or audit).

When possible, IO shall accept the action plan without impact on the workshop schedule.

After implementation of the action plan, remedial action(s), corrective action(s) and evidence(s) are approved by IO (if required).

5.6 Case of NC related to CFSI

In case the Non-Conformity deals with a Counterfeit, Fraudulent and Suspect Item (CFSI), the Head of the EPNS Division informs the ASN using the template [Déclaration d'évènement significatif à l'ASN \(SKKSP3\)](#), after validation by the Director General. Such cases will be treated and reported as significant event following the regulatory requirements.

The template [ITER_D_SRVZKZ - Compte-rendu d'évènement significatif](#) is used for this analysis. After validation by the Director General, the analysis report is sent by the Head of the EPNS Division to the ASN within 2 months after the detection of the CFSI.

For identification (symptoms) of CFSI items the following guideline need to be followed and consulted by the stakeholders: [27] - [XKUKAX - Guideline for identification \(Symptoms\) of Counterfeit, Fraudulent and Suspect Items \(CFSI\)](#).

All the non-conformities dealing with a CFSI shall be evaluated by IO QARO and IO SRO to:

- ensure confirmation of CFSI case,
- initiate and perform RCA and
- ensure further escalation to EPNS Head.

5.7 Internal NC of performers.

During contracts / PAs implementation, the performers (DAs, Suppliers, contractors, sub-contractors) may identify internal NC that need to be managed internally within the performers organization without involving IO and other external entities.

Such internal nonconformities (NC) has the following characteristics:

- NC will not affect the final products and activities delivered to IO or different other entities (other DAs, supplier, contractor) in the scope of ITER project,

- NC will not have impact on contractual/ PAs requirements
- NC will not have impact on cost and schedule related to ITER project and
- NC will not have impact on regulatory requirements applicable for ITER project.

The performer internal NCRs, shall be managed by external performers in accordance with their internal NCR procedures.

The performers shall maintain fully traceability and evidences for internal NCR closure, to be available during the IO/ DAs audits and inspections.

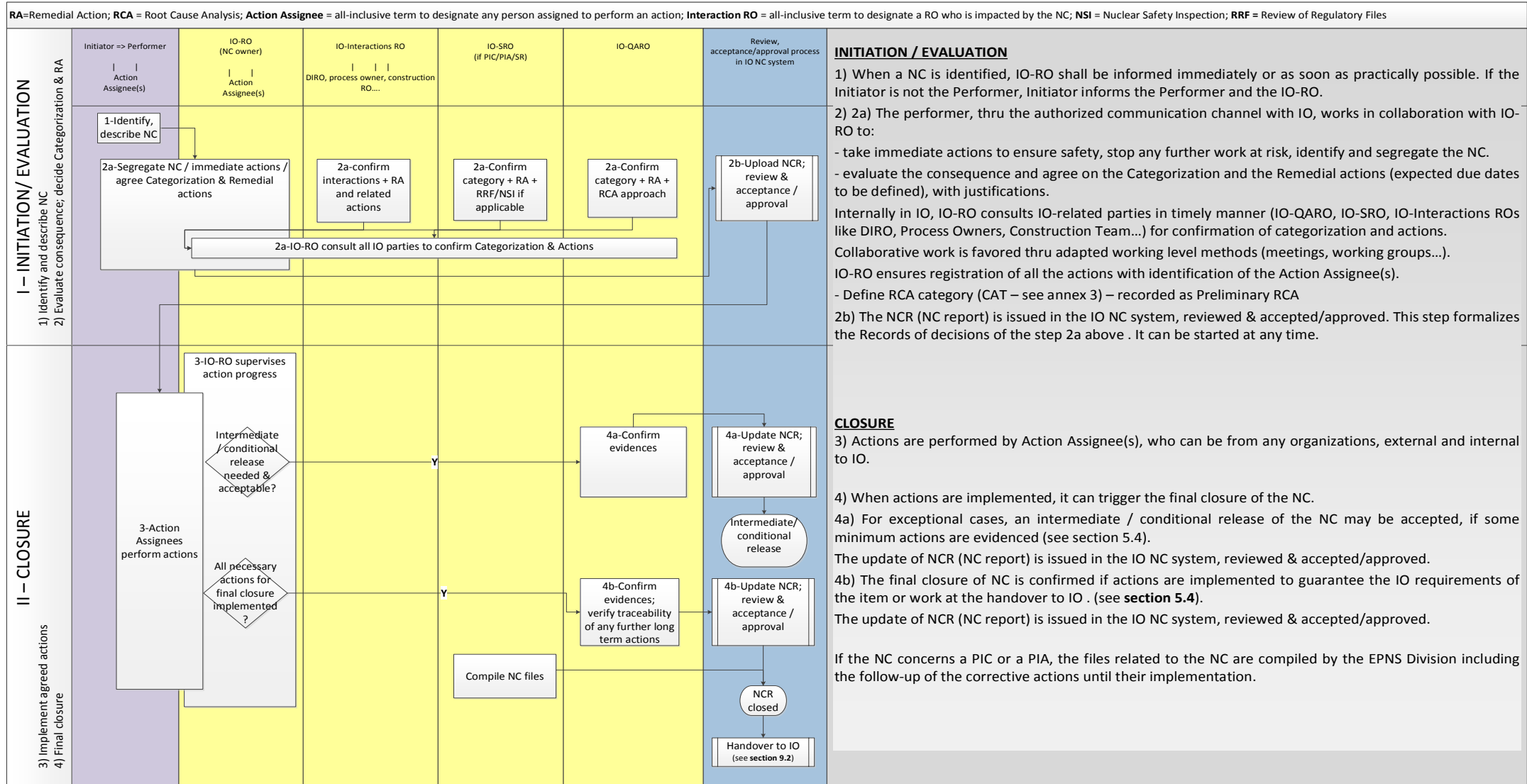
Internal NC of performers shall be recorded using performer's NCR templates and internal database (if applicable). A list (log/ register) of internal NCRs need to be maintained by the performer to allow strict control of NCR stages, trend reports and analyses. This internal NCR log shall be available at IO/ DAs request during the audits and inspections.

IO internal NCRs: For such NC (with no impact on other organizations), the involved stakeholders will be IO staff only and review / approval cycle will respect present procedure requirements. A dedicated working instruction – MQP level 3 (with no impact on DAs) will be prepared for detailing the instructions for treatment of IO internal NCRs.

6. Workflow

The work flow focuses on Roles and Responsibilities in a generic way. Two main stages of the process are defined, for both Product NC and Process NC:

- I. Initiation / evaluation:** This stage consists in taking immediate actions, describing the NC, evaluating the impact and agreeing on categorization and remedial actions.
- II. Closure:** This stage consists in implementing the actions agreed and in closing the NC with the required evidences.



7. Responsibilities

- The Performers shall ensure the implementation of the requirements of this document to control nonconformities.
- For NC under performers responsibility, the final acceptance by IO of Nonconformity Reports:
 - a) Is limited to the particular contract and item referred in the report;
 - b) Does not relieve the performer of any contractual obligations and responsibilities.
- Detailed stakeholders and their roles and responsibilities are listed in the following table.

#	Stakeholder	Responsibilities
1	Initiator	• Detect and identifies NC and notifies IO; • Alerts the involved parties, primarily the affected IO-RO as soon as practically possible (within one week) and with necessary details; The IO-RO may decide that the NC is actually an “Internal Non-conformity” and stop the initiation of the NC in IO NC system. • Notify the Performer, if different from the Initiator; • Responsible for registering or triggering the registration of the NC into the IO NC system; Sometimes, it can be directly the IO-RO who detects and identifies NC.
2	Performer	When Performer is the person detecting the NC, executes actions of Initiator as above; • Segregates NC, take immediate remedial actions. Stop (as per IO agreement) any further related work on the item until a decision on the NC is taken; • Make initial written proposal of the RCA categorization, using CAT and remedial actions. Initiates problem-solving technique to treat the NC, including as appropriate RCA and preliminary analysis of causes as soon as practically possible (typically within a couple of weeks). Performer can seek assistance from IO-QARO in the methodology of NC problem solving techniques. • Through the authorized communication channel with IO and DA’ (in case of PA implementation), collaborates with IO-RO/ DA-RO to achieve the appropriate conclusion on NC categorization and actions (remedial actions and corrective actions). • Provides evidence of progress of the NC treatment to the IO-RO in a pro-active and timely manner. • Complementary to the required information by IO, manage comprehensively the NC in NC system. • The performer is the designated entity for NCR closure, responsible for implementation of remedial/corrective actions and trigger the NCR closure stage in NC System.
3	IO-RO NC-Owner	• IO Person assigned responsible : ○ For the coordination and control of the activities in the NC treatment; ○ Ensuring that the NC is documented and recorded in the IO NC system correctly. ○ Triggering and guarantying the closure of the NC. For that , the IO-RO shall: • Consult all related-parties, including IO-Interactions RO, IO-SRO (for NC concerning PIC and/or PIA), PE/NPE expert (as required) and IO-QARO to confirm categorization and actions decided. • Agree with the Performer and DA-RO (in case of PA implementation) on the apparent cause analysis tree and remedial actions; Participate and conclude on the impact assessment, including impact on IO Baseline documentation. • In case there is any change action(s) on IO Baseline documentation, manage the implementation according to [11], manage the initiation of a Project Change Request (PCR), if so requested by the DIRO. • Shall ensure that the NC is issued and registered in the IO NC system correctly. • Track the NC and related actions until the final closure of the NC in IO NC system.

#	Stakeholder	Responsibilities
		- In the review and approval cycle of the NC reports, is either the person Approving³ or is Reviewer (if acceptance/approval is done by higher level of organisation). - IO-RO can seek assistance from IO-QARO in the methodology of NC problem solving and RCA techniques. In case of dispute to find and designate an IO-RO, see section 10
4	IO-SRO	- Checks if PIC, PIA, Safety Related (SR), are properly designated. - Agrees on the NC categorization (for NC concerning PIC and/or PIA). - Assess Safety impact and validates action proposal. - Reviews with respect to Regulations [1], [2], [3] & [4] - Is part of the review process of the NC reports, as appropriate for NC concerning PIC and/or PIA. - Confirms if there is a need for Safety Review of Regulatory Files [9]0 and / or Nuclear Safety Inspection [10]0 , and call for those processes as necessary.
5	PE Group	- Checks if PE/ NPE are properly designated. - Agrees on the NC categorization (if the NC is PE/NPE relevant). - Consult (A)NB for major product NCR and process NCR - Assess statutory & regulatory impact and validates action proposal - Review with respect to Regulations [1], [2], [3] & [4]. - Is part of the review process of the NC reports, as appropriate.
6	IO-Interactions RO (DIRO) <u>For Major NC only</u>	- Checks the NC potential impact on other areas than the original scope of the NC, review and confirm apparent cause analysis using CAT and remedial action proposal. - For NC at manufacturing stage, it includes the assessment of impact on Assembly, Installation and Operations. - Is part of the review process of the NC reports, as appropriate. - In case there is any change action(s) on IO Baseline documentation, ensure it is implemented according to [11]. - Analyse the NCR considering the design impact and if PCR is required to trigger further upper level project changes as per [26].
7	IO-QARO	- Checks the compliance of the NC process - Checks if proper RCA is undertaken, commensurate to the impact and risk of the NC, along with the necessary action(s). - Can provide a support to the stakeholders, as necessary, in the methodology of NC problem solving techniques. - Is part of the review process of the NC reports, as appropriate. - Checks the evidences required to grant the closure of NC. It involves traceability of the actions until implementation. - Confirms if any long-term corrective actions can be tracked in a separate system, to allow final closure of the NC on the individual item or work, and verifies the traceability of those actions. - In IO, provide assistance to sort what are internal IO actions and what are external IO actions. Indeed, an NC by an external performer may reveal the need for actions within IO. In that case IO-QARO ensures opening of the relevant NC/CAR in the appropriate IO system. - Facilitate the coordination between the stakeholders, and may become the IO NC

³ The approval level of NC can be delegated to a different IO stakeholder (upper level or similar level) if agreed with Department Head of requester and approved by process owner. Such delegation regarding approval level of NC shall be documented with clear justifications using deviation request applied as per [30].

#	Stakeholder	Responsibilities
		owner, in case of complex NC, involving different processes.
8	QMD	- In application of GIN007 [19], QMD ensures that NCs are closed in due time. - Provide NC statistics and KPIs to monitor the effectiveness of the NC process.
9	IO-Tech Staff	- Person is designated by IO-RO as appropriate. - Review the NC regarding the technical aspects - added as additional reviewers of NC.
10	IO Process owner	- For IO internal NC, related IO processes and procedures deficiencies (need for improvements), the process owner is responsible for NCR review for confirmation of RCA and remedial and corrective actions implementation. - Ensure the process improvement (if needed) revising the affected procedures and working instruction as per decided actions triggered by NC evaluation.
11	IO DH or upper level	For IO internal NCs, the approval shall be under DH of affected entity (or appointed representative) responsibility.
12	DA-RO	- DA Person assigned responsible : - For the coordination and control of the activities in the NC treatment within DA; - Ensuring that the NC is documented and recorded in the IO NC system correctly. - Triggering and guarantying the closure of the NC ensuring continuously interface/communication with performer. Ensure continuous communication / interface with IO-RO to achieve the appropriate conclusion on NCR categorization, agree on related actions, remedial, and corrective actions (as required) and NCR closure.

8. Records/Outputs

- The form in Appendix 1 lists the minimum information required for managing a NC report.
 - The template [22] or template [25] is proposed to address this minimum information. Alternative formats (including in electronic form – NCR database) which include the essential metadata may be acceptable. They shall be subject to IO Quality Management Division acceptance in advance of their intended use.
- NCs are an integral part of a contract and PAs. Upon completion of the work, NC reports shall be included in the data package handed over to IO (**see chapter 9.2**).
- In IO, a NC register shall be maintained including all relevant metadata. The IO-RO is the Responsible person to ensure record of NC reports in the IO NC system, for the whole lifetime of the ITER project.

9. Link with other processes

9.1. Link with other ‘Quality Assurance’ processes (QA audit, CAR)

- The 3 following procedures have the same goal of addressing nonconformities and having proper corrective actions implemented. These procedures are governed by the same principles based on standard quality practices: problem description, Root Cause Analysis (RCA), corrective actions implementation and verification of effectiveness. They are complementary to address all types of inputs.
 - Nonconformities resulting from QA audits are managed through detailed steps described in [20]0
 - The CAR procedure [21]0 describes the process to manage Corrective Actions Requests as a result of other sources (for example DG decision, ASN request, a management review...). What is important is that actions are implemented by one of the above process, and that there is no duplication. This verification is done by Quality Management Division QMD.

9.2. Link with ‘Procurement’

As elements governing ITER Procurement Quality Requirements0:

- NCs are an integral part of a contract. Upon completion of the work, NC reports together with relevant documentary evidence shall be included in the data package handed over to IO.
 - For Manufacturing, it is governed by the process for Producing a Contractors Release Note 0 and Manufacturing Dossier.
 - For Assembly&Installation, it is is governed by the process for Mechanical Completion Dossier 0.
- During execution of Inspection Plans governed by [14], if modifications appears to be necessary due to Nonconformity (such as repair...), the NC report should be referred in the Inspection Plan.
- The products / activities shall be released for delivery only if all the related NCR’s are closed. The release of the PAs credits / contracts termination shall be applied if all the related NCRs are closed.
For exceptional cases, please see conditional release - chapter 5.4.

9.3. Link with ‘Nuclear safety’

- In the treatment of NC, SRO may trigger the need for the Review of Regulatory File (RRF) [9]0 or / and for a Nuclear Safety Inspection (NSI) [10]0. See **chapter 7** (role of IO-SRO).
- Nonconformities survey process for PIC and PIA shall be performed by SCG in accordance with Articles 2.6.3, 2.7.1 and 2.7.3 of the INB Order.
- An biannual assessment report shall be prepared by SCG and approved by SQD Head, for global review of non-conformities on the cumulated effect of uncorrected discrepancies on the installation, and identify and analyse the recurrence propensity for similar types of NC as requested by the article 2.7.1 of the INB Order [1]. The SCG is responsible for the annual assessment of trends and the cumulated effect of NCRs and analyse the recurrence propensity for similar types of nonconformities.
- Input data for such report could also come from the lessons-learned feedback as per [34].

9.4. Link with ‘Configuration Management’ process

- In the NC categorization, one of the criteria is the level of control (level 1/2/3/4/5) of the IO Baseline Documentation impacted. Those levels are governed by IO procedure [11].
- If the treatment of NC implies the modification of IO Baseline Documentation, the proper Change Action(s), under the relevant Level of CCB shall be managed according to [11] (**chapter 7**) and PCR [26].
- In **chapter 10** (Dispute and Resolution), the PIM process [13] can be called (Project Issue Management).

9.5. Link with ‘Documents and Records’

- In **section 0**, the present procedure 22F53X describes the roles of IO Stakeholders as reviewers of the NC reports, as an input to SOA (Sign-Off Authority) [8]0. It can be summarized in following table:

	IO-RO	IO-Interactions RO	IO-QARO	IO-SRO	PE Group
Minor NC	Approve ⁴ or Review	-	Review	Review (if PIC/PIA/SR)	Review (if PE/NPE)
Major		At minimum IO- DIRO Review Stage I ⁵			

NC					
----	--	--	--	--	--

SOA 0 being document-based does not give indication of the status of a document within a workflow. The present procedure 22F53X develops the stages of NC treatment, each of them grading the required minimum list of reviewers. Therefore, in case of contradiction, this MQP procedure 22F53X, and its derived MQP Level 3 documents, take(s) precedence.

9.6. Link with “PE/NPE conformity assessment”

In the treatment of NC, PE Group may trigger the need to update a procedure or any document used as support of the Quality System accepted by ANB.

If during the resolution of an existing nonconformity, a visual examination required for the final assessment of the PE/NPE is impacted, IO will allow ANB to perform a new visual examination.

The pressure test could be performed even if all the nonconformities are not closed if IO provides evidences to ANB that these opened non-conformities will not have an impact on the pressure test.

9.7. Link with Finance & budget process

Management of I-NC is part of finance & budget process and shall be applied in accordance with [28].

10. Dispute and resolution

Criteria for triggering escalation includes, but is not limited to:

- dispute on the way to close a NC;
- long aging NC - opened for a long time (typically more than 12 months) without any justification;
- dispute on ownership of NC; as an example, when there is multiple interfaces involved (e.g. different systems, multiple Performers and organisations ...).

In IO, the mechanism how to escalate is as follows:

- Submission first to Division Head (DH) level;
- If resolution within IO is not gained at the Division Head (DH) level, it will be submitted to the QMD Head and technical Department Head level;
- If still no resolution is made, then the NC will be submitted to “PIM” (project issue management; issue at PIM [13]).

11. KPI

IO has established 2 KPI indicators to assess the efficiency of the process:

1. The time between the detection of the NC and submission of NC (5 working days).
2. The time between the detection date of the NCR and the closure of NCR. – LL NCR

The internal specific KPIs for monitoring of NCR management performance may be established by IO process owner and shall be monitored/reported as per Management Review procedure [33].

In application of QAP [5] section 2.9,

“ The Non-conformities shall be resolved with high priority and this resolution shall not exceed 9 months in average and 12 months individually, except initial agreement from the IO DG or the QMD Head.”

⁴ IO-RO is either the person Accepting/Approving (as per contract definition), or is Reviewer (if acceptance/approval by higher level of organisation).

For IO NC the approval shall be obtained from process owner or DH (see chapter 7). The approval level on DAs site shall be applied as per DA NCR procedures

⁵ Stage I is the Initiation stage as per **section 0**, with one objective being agreement on remedial actions.

If long time (Long Aging - LL) is necessary to close the NC, justification shall be provided by NCR owner (with performer support) and recorded. The detailed requirements regarding long aging NCRs management are described in the [31].

Appendix 1: List of related information / data to be provided in NC system template

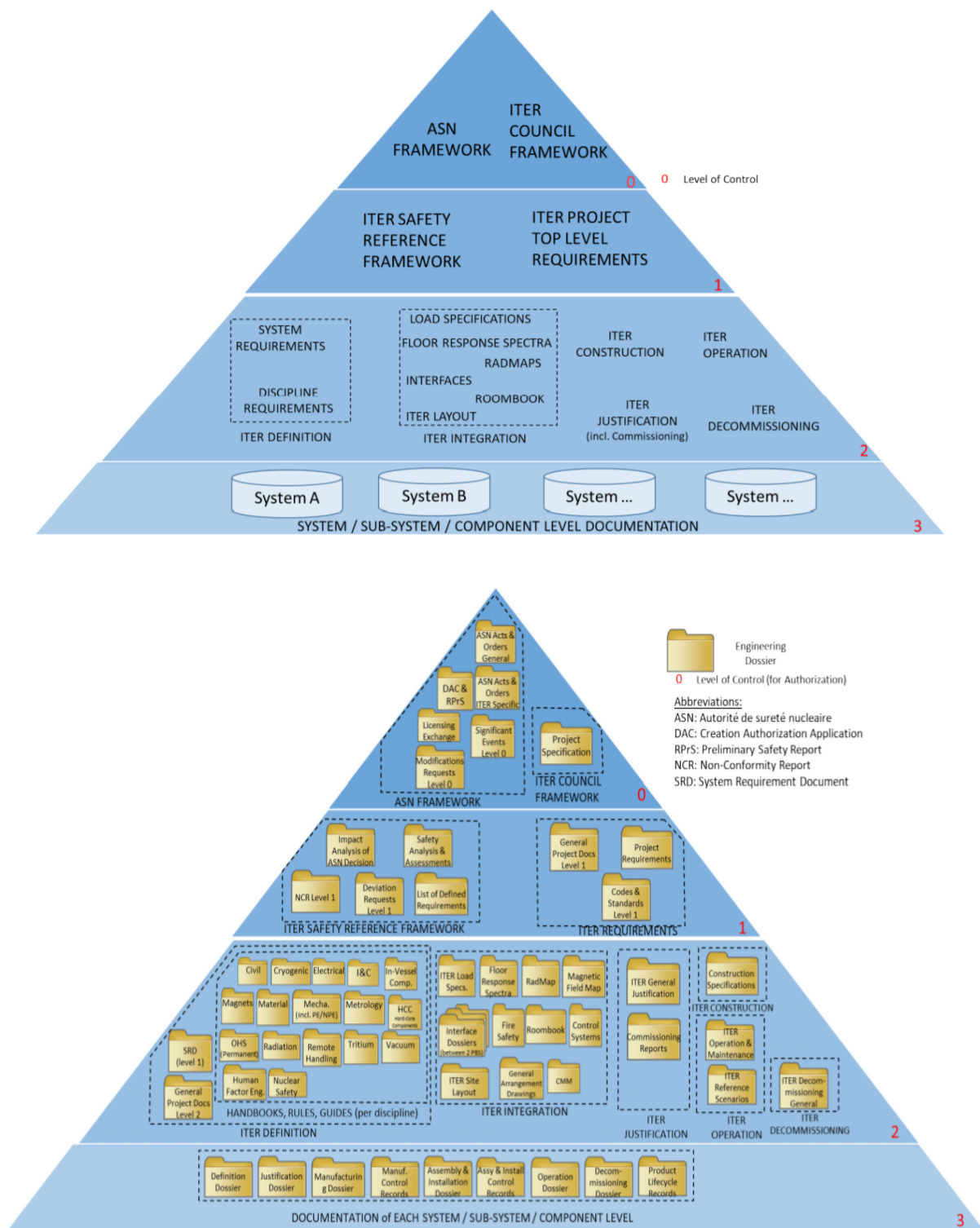
	Field	M = Mandatory O = Optional
NC Initiation Stage I	Title of Nonconformity	M
	External Performer(s) NC Reference(s)	M (if applicable)
	ITER Contract reference (PA/Task Agreement / Direct contract as applicable)	M (if applicable)
	DA	M (if applicable)
	Supplier / Contractor	M (if applicable)
	Affected DA (other than related contact)	M
	Plant Breakdown Structure (PBS)	M
	Item / Work identification and localization (objective is to keep traceability)	M
	FR / PNI/ SN (for product NC only) – see note **	M
	CWP	O
	NC Category (Major or Minor)	M
	Quality Class	O
	Is PIC? PIA? SR?	M
	Date of NC detection	M
	Requirements	M
	Description of the Nonconformity vs. Requirement	M
	Proposed preliminary Remedial Action(s) and description	M
	Initiator and organization (with signature *)	M
NC evaluation Stage I	Confirmation of final Remedial Action(s) (expected completion date for closure)	M
	Justification of Remedial Action (s)	M
	Preliminary Root Causes Analysis RCA (following CAT – annex 3)	M
	Impacted Documents, including Baseline Documents	M
	Target date for NC closure	M
	Supporting Documents	O
	Is a PCR/CCB Required? (if Y, reference #)	M (MAJOR)
	Is an RRF/NSI Required? (if Y, reference #)	M (if PIC/PIA/SR)
	Performer(s) RO (with signature*)	M
	IO ROs (with signature*)	M
	IO Reviewers (with signature*)	M
	IO Acceptance/Approval (with signature *)	M

NC Closure Stage II	Follow-up on remedial action(s): when implemented + evidences	M
	Root Cause Analysis	M (Major)
	Are Corrective (and Preventive/risk-based) Actions Required? Y/N If Y, description of actions and due date.	M (Major)
	Follow-up on Corrective actions required for final NC closure: when implemented + evidences	M (Major)
	Performer(s) RO (with signature *)	M
	IO ROs (with signature *)	M
	IO Reviewers (with signature *)	M
	IO Acceptance/Approval (with signature *)	M

(*) ‘with signature’ means that there shall be a formal trace (electronic signature –NCR database) of the signature of the person.

(**) When the NC affect a single item, the item SN (serial Number), FR (functional reference) and PNI identifier shall be used. When the NC affect an entire batch, the PNI shall be used to identify all concerned items

Appendix 2 – TECHNICAL BASELINES overview levels as per [11] – see ITER baseline diagram

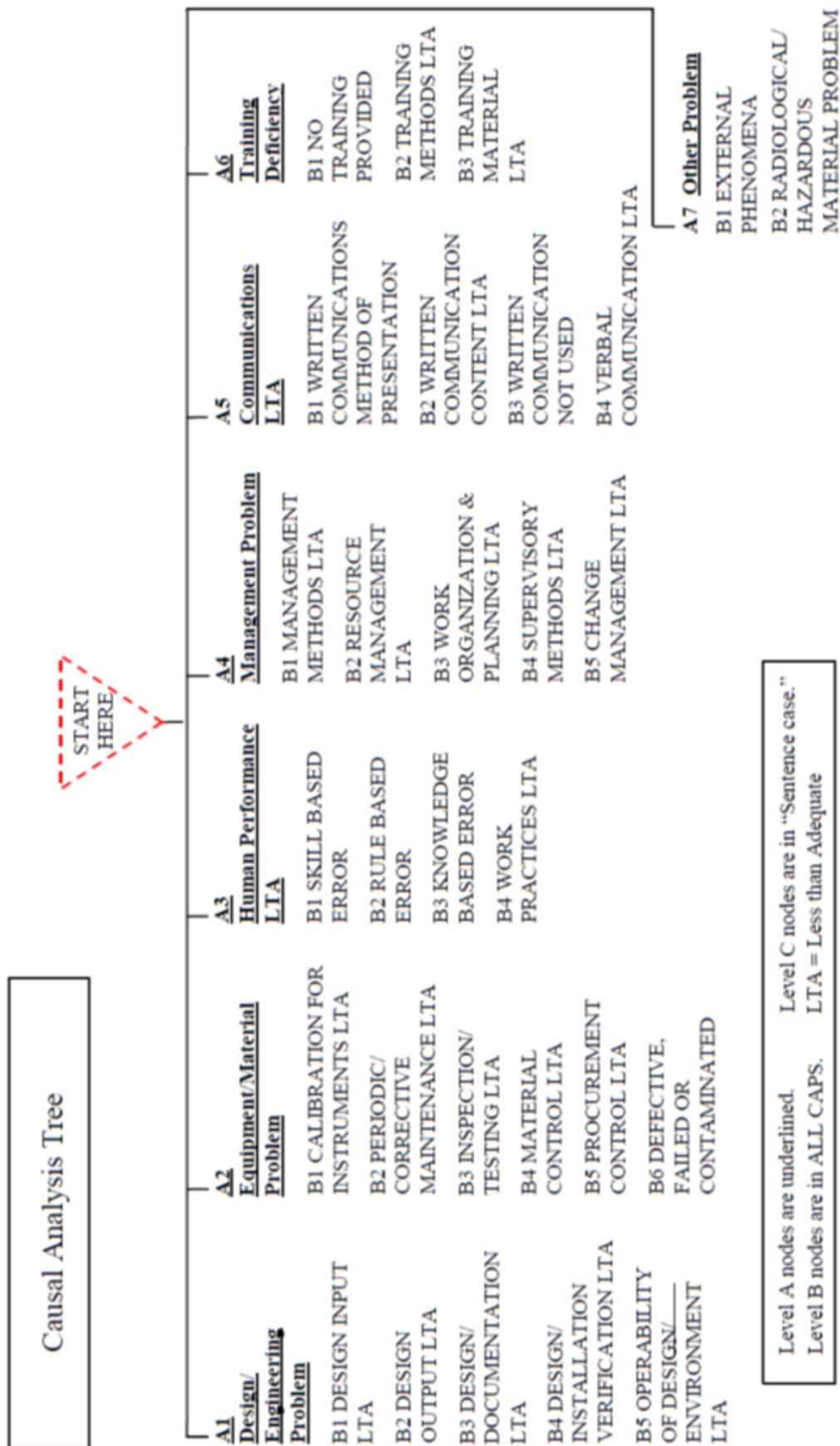


Details of ITER baselines with Engineering dossiers type and baseline levels as per [11].

MANAGEMENT BASELINES.

The management baseline requirements are indicated in chapter 9.5 of [ITER_D_2NCR3F - ITER Project Management Plan \(PMP\)](#).

Appendix 3 – Causal Analysis Tree for Root Cause Analysis (RCA)



Technical Specification of PBS.55.C6 FIR Laser System

ITER Project Japan Domestic Agency

	Name	Affiliation	Date	Signature
Author	IMAZAWA Ryota (TRO)	Plasma Diagnostics Group	18-July-2023	今澤 良太
Co-author	MUKAI Tomoya	Plasma Diagnostics Group	18-July-2023	向井 智也
Reviewers	HASHIMOTO Yasunori	Plasma Diagnostics Group	19-July-2023	橋本 慰登
Reviewers	HATAE Takaki	Dept. of ITER Project	20-July-2023	渡多江 仰紀
Approver	NUNOYA Yoshihiko (RPGL)	Plasma Diagnostics Group	21-July-2023	沼谷 嘉彦

Change log

Branch no. (date) (IDM number)	Change description
- (21-July-2023) (9ECN97_v1.0)	First version
	—

Table of Contents

1. INTRODUCTION.....	5
1.1. PURPOSE	5
1.2. SCOPE	5
1.3. DEFINITIONS	5
1.4. REFERENCES	6
2. OVERVIEW.....	7
2.1. HARDWARE.....	7
2.2. CONTROL	12
3. HARDWARE ARCHITECTURE OF FIR LASER SYSTEM	13
3.1. DIAGRAMS, COMPONENT LIST AND DRAWINGS	13
3.2. CONNECTION BETWEEN PLC FOR LASER CONTROL AND OTHER DEVICES	14
3.3. IP ADDRESS AND SERIAL COMMUNICATION PARAMETER.....	16
4. SOFTWARE ARCHITECTURE OF FIR LASER SYSTEM.....	17
4.1. PLC FOR LASER CONTROL.....	17
4.1.1. <i>Internal Processing</i>	17
4.1.2. <i>Interlock</i>	17
4.2. I/O SIGNAL LIST.....	17
4.3. DATA EXCHANGE BETWEEN LASE FC AND PLC FOR LASER CONTROL	18
4.4. BUILDING LASER SYSTEM I&C USING SDD EDITOR.....	18
4.4.1. <i>Overall Development Workflow</i>	18
4.4.2. <i>Building EPICS IOCs</i>	18
4.4.3. <i>Functions and Variables</i>	19
4.4.4. <i>EPICS Modules</i>	19
4.5. USER INTERFACE (HMI)	20
4.5.1. <i>Touch Panel for Local Control</i>	20
4.5.2. <i>GUI for Remote Control</i>	23
APPENDIX I:	OPTICAL LAYOUT DIAGRAM
APPENDIX II:	VACUUM SYSTEM DIAGRAM
APPENDIX III:	COMPRESSED AIR SYSTEM DIAGRAM
APPENDIX IV:	COOLING WATER SYSTEM DIAGRAM
APPENDIX V:	CONTROL SYSTEM DIAGRAM
APPENDIX VI:	ONE LINE DIAGRAM
APPENDIX VII:	CIRCUIT DIAGRAM
APPENDIX IIX:	CONTROL CABINET DIAGRAM
APPENDIX IX:	TERMINAL BLOCK DIAGRAM
APPENDIX X:	COMPONENT LIST
APPENDIX XI:	MECHANICAL DRAWING
APPENDIX XII:	PLC INTERNAL PROCESSING FLOWCHART

APPENDIX XIII: INTERLOCK CONDITION STATEMENT
APPENDIX XIV: I/O SIGNAL LIST

1. Introduction

1.1. Purpose

ITER Poloidal Polarimeter (PoPola, PBS.55.C6) injects a linearly polarized FIR (far-infrared) laser beam into a plasma and determines the current profile inside the plasma from the measurement of polarization state change generated in the plasma. JADA has developed a prototype FIR laser together with TOYAMA Co., Ltd.¹, and the prototype is sold as product model T-LASER-FIR-A by TOYAMA. The TOYAMA's FIR laser will be customized and will be delivered to ITER. This document provides the technical specifications of the FIR laser system to be delivered to ITER.

1.2. Scope

This document covers the following system and subsystems:

- PoPola (PBS.55.C6)

The scope of this document is only the technical specifications of the FIR laser system.

1.3. Definitions

CA	Channel Access
CCS	CODAC Core System
CIP	Common Industrial Protocol
CoE	CAN over EtherCAT
CSS	Control System Studio
EGU	Engineering unit
EPICS	Experimental Physics & Industrial Control System
FBD	Function Block Diagram
FC	Fast Controller
FIR	Far Infra-Red
FSOE	Fail Safety over EtherCAT
I&C	Instrumentation and Control
I/O	Input/Output
IOC	Input / Output Controller
MCR	Main Control Room
MFC	Mass Flow Controller
OPC UA	OPC Unified Architecture
PLC	Programmable Logic Controller
PoPola	Poloidal Polarimeter
PSH	Plant System Host
PV	Process Variable or Process Value
SDD	Self-Description Data

¹ <http://www.toyama-en.com/>

ST	Structured Text
SV	Set Value

For a complete list of ITER abbreviations see: [ITER_D_2MU6W5 - ITER Abbreviations](#)

1.4. References

Table 1 Reference documents

Ref No.	Reference Name	IDM Reference	Version No.
[RD 1]	OPC UA Integration User Manual	32N6MJ	1.3
[RD 2]	CODAC Core System Overview	34SDZ5	7.1
[RD 3]	CODAC Core System Application Development Manual	33T8LW	5.9
[RD 4]	Enterprise Architect Project Exchange with SDD or PSP – Work Instruction	REFLY3	2.0
[RD 5]	CODAC Core System Self-Description Data Editor User Manual	32Z4W2	10.3

2. Overview

2.1. Hardware

Figure 1 shows the schematics of the FIR laser, and the FIR laser consists of carbon dioxide laser (CO₂ laser) and FIR cavity fulfilled with methanol gas. The CO₂ laser emits laser beam with wavelength of 9.6 μm , and the laser beam with the wavelength of 9.6 μm excites that with wavelength of 119 μm in the FIR cavity. Finally, the FIR laser emits laser beam with wavelength of 119 μm .

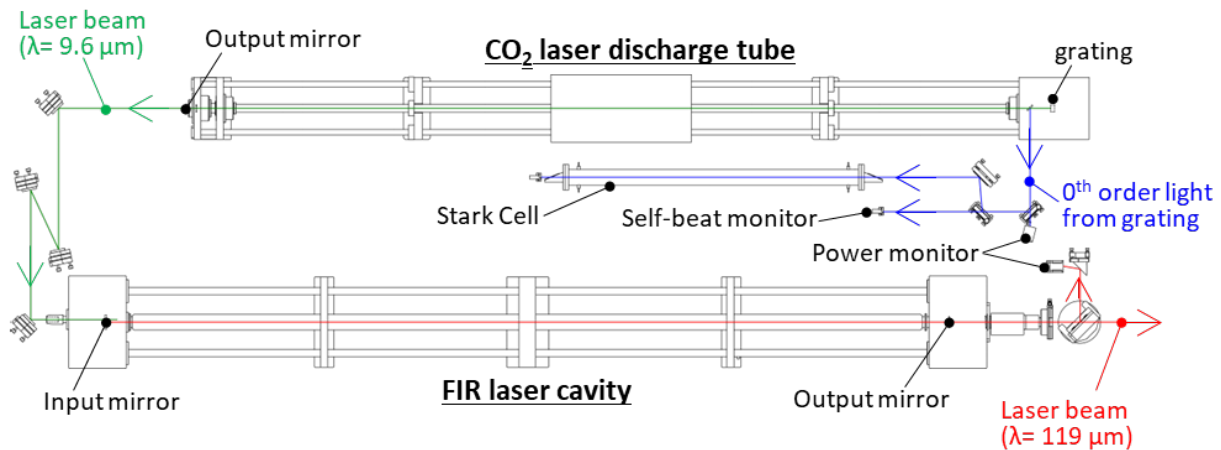


Figure 1 Schematics of FIR laser

The CO₂ laser is a discharge pumped laser and consists of the parts below.

- Discharge tubes with an output mirror and a grating.
- A high voltage power supply for making glow discharge inside the discharge tube.
- Mass flow controllers and valves for supplying CO₂, N₂ and He gas to the discharge tube.
- Vacuum pumps and valves for evacuating the gas from the discharge tube.
- Power meters and detectors to monitor the laser quality.
- Flow meters and valves for supplying cooling water to the discharge tube and mirrors.
- A visible laser and mirrors for an initial alignment.

The parts related to the FIR cavity are as follows.

- A discharge tube with input mirror and output mirror.
- Mass flow controllers and valves for supplying CH₃OH (methanol) and He gas to the discharge tube.
- Vacuum pumps and valves for evacuating the gas from the discharge tube.
- Power meters and detectors to monitor the laser quality.
- Flow meters and valves for supplying cooling water to the discharge tube and mirrors.
- A visible laser and mirrors for an initial alignment.

In addition to the parts listed above, the FIR laser includes the parts below.

- Programmable logic controllers (PLC) with a touch panel.
- An optical table with a laser enclosure.
- An emergency stop button.
- An interface with door switches.
- A laser shutter.
- An electrical power supply.

High level configuration of these components is given by diagrams of Figure 2 – Figure 6. Figure 2 shows diagram of laser propagation, Figure 3 shows diagram of gas flow, Figure 4 shows diagram of cooling water flow, Figure 5 shows diagram of analog signal, and Figure 6 shows diagram of serial communication and fieldbus. The diagrams also provide identification number (ID) of the parts. For instance, you can find CL-GT1, CL-GT2 and FL-GT in Figure 2. Abbreviations used in IDs such as GT, CL and FL indicate what the part is. So, these ID means that CL-GT1 is glass tube #1 of the CO₂ laser, CL-GT2 is glass tube #2 of the CO₂ laser, and FL-GT is a glass tube of the CO₂ laser.

Detailed diagrams are given by Appendix I – IX, and the full list of the components and IDs are given by Appendix X.

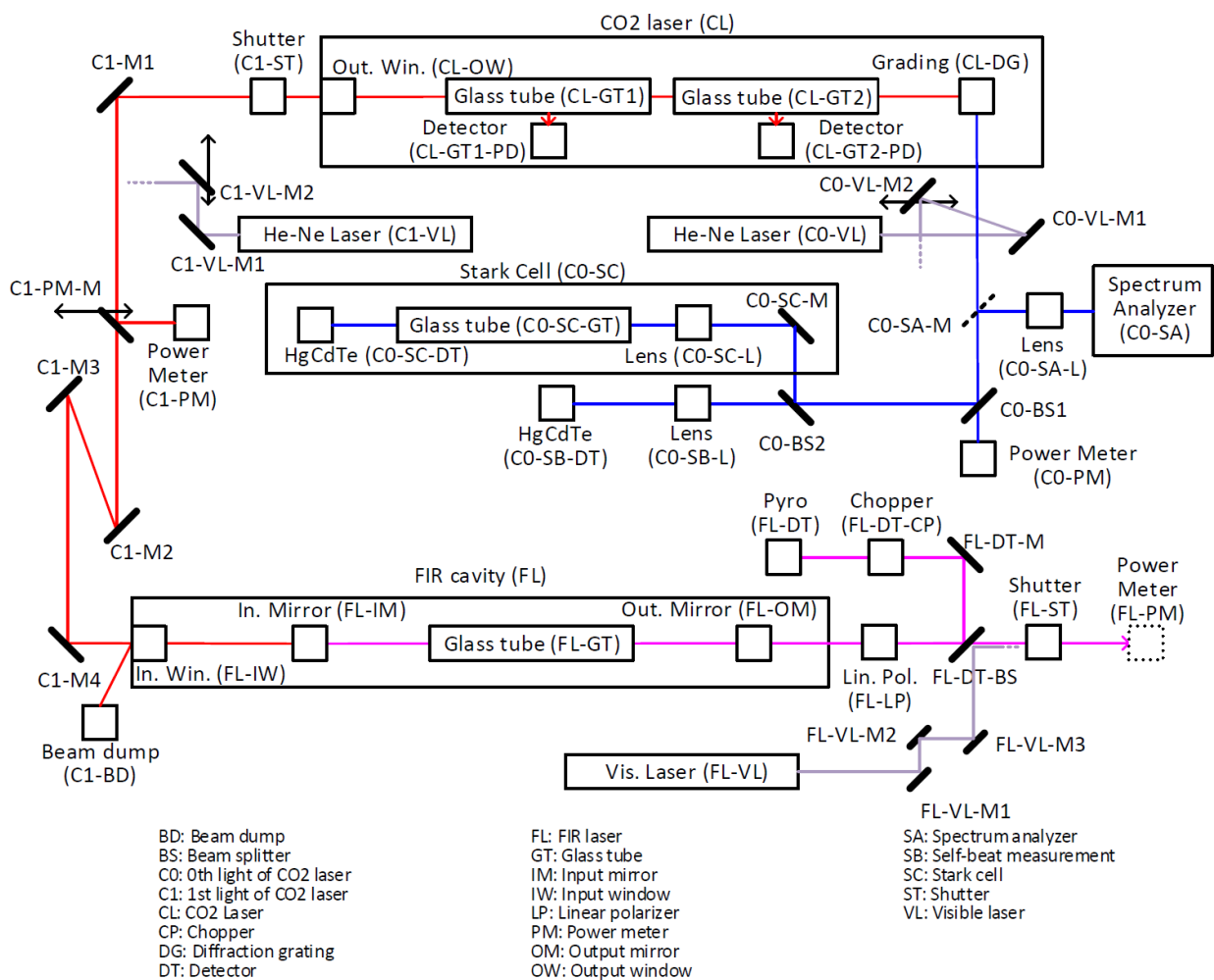


Figure 2 Diagram showing components associated with laser propagation

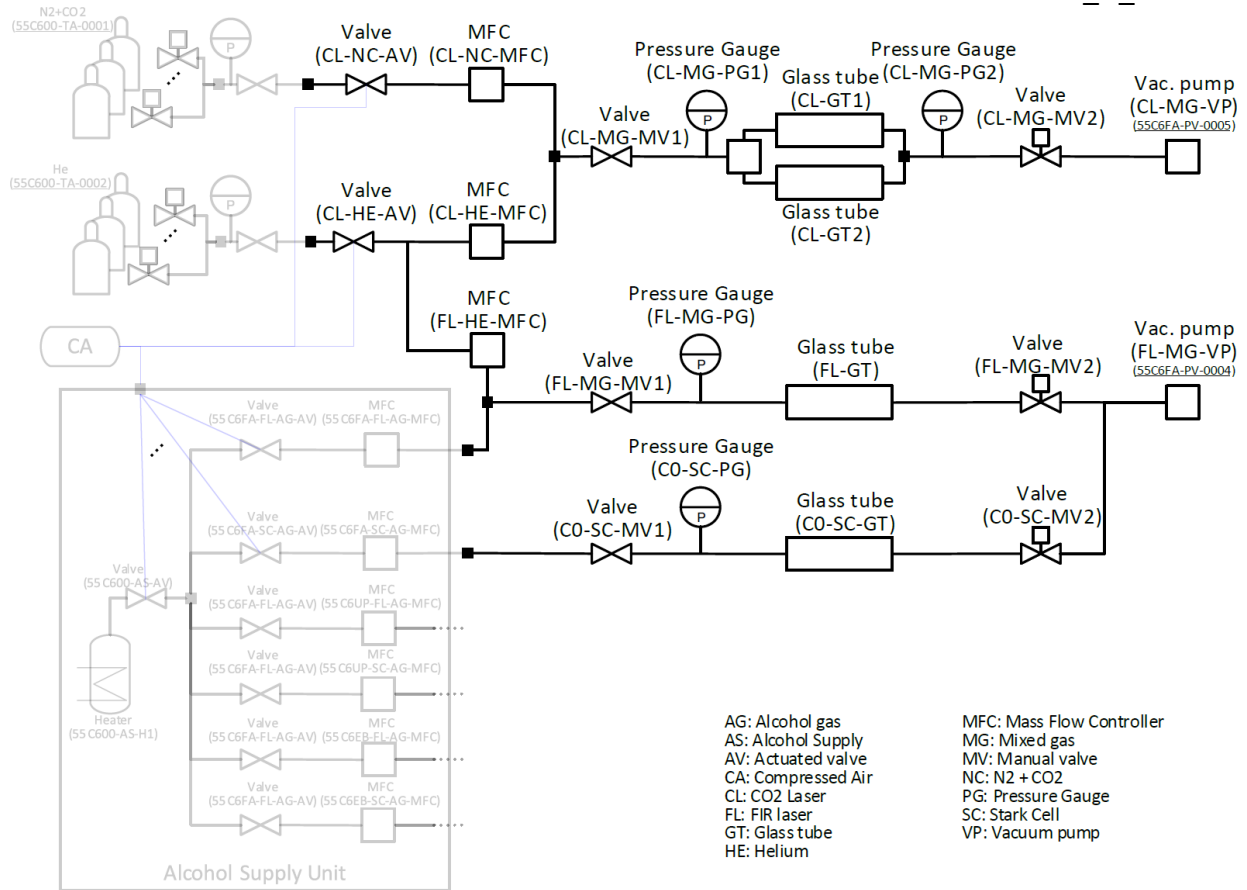


Figure 3 Diagram showing components associated with gas flow.
Grayed components are beyond the scope of the FIR laser.

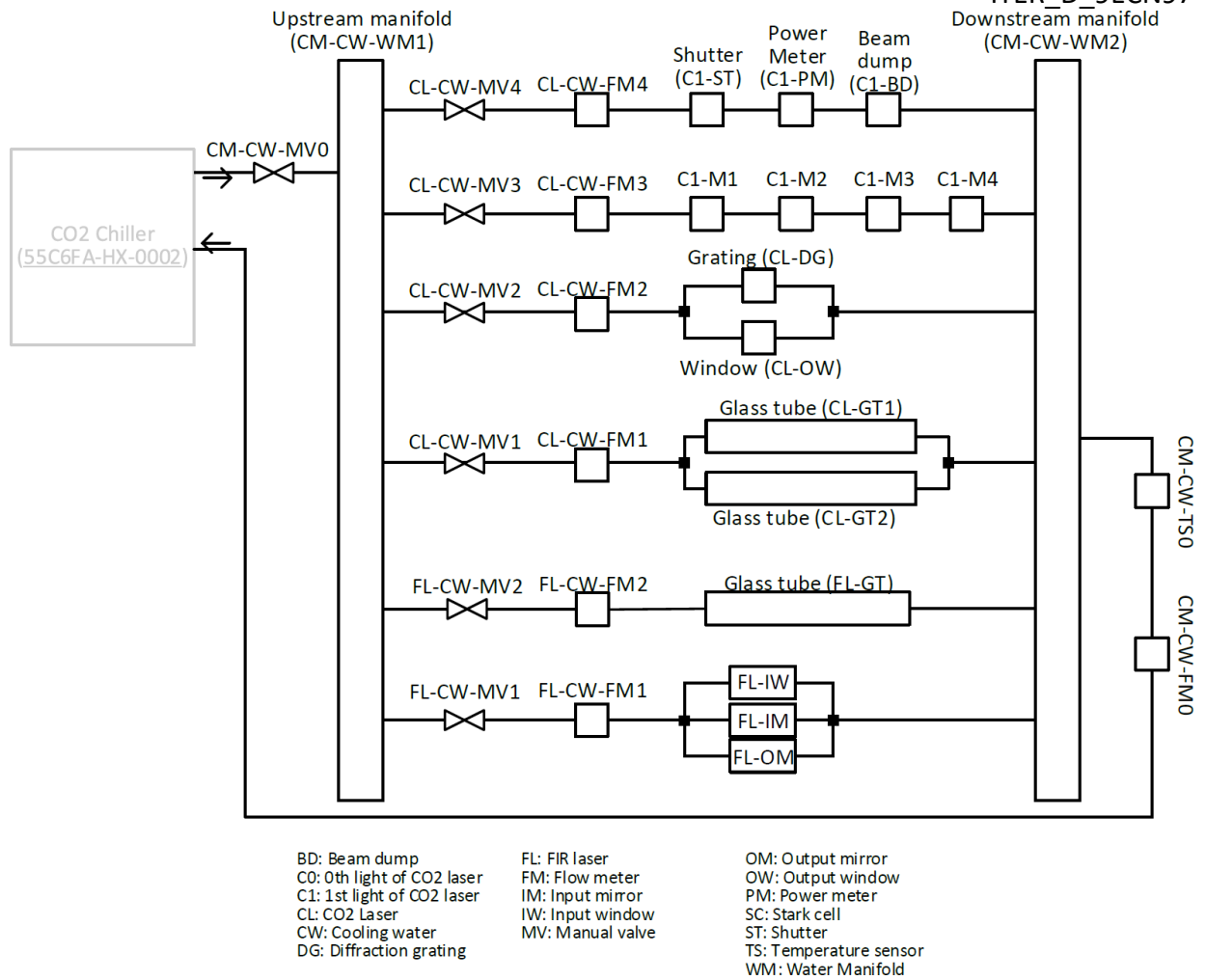
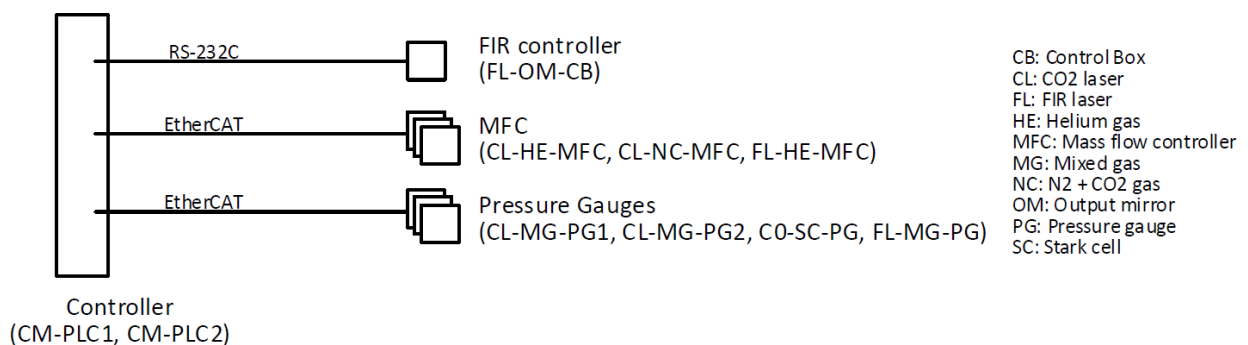
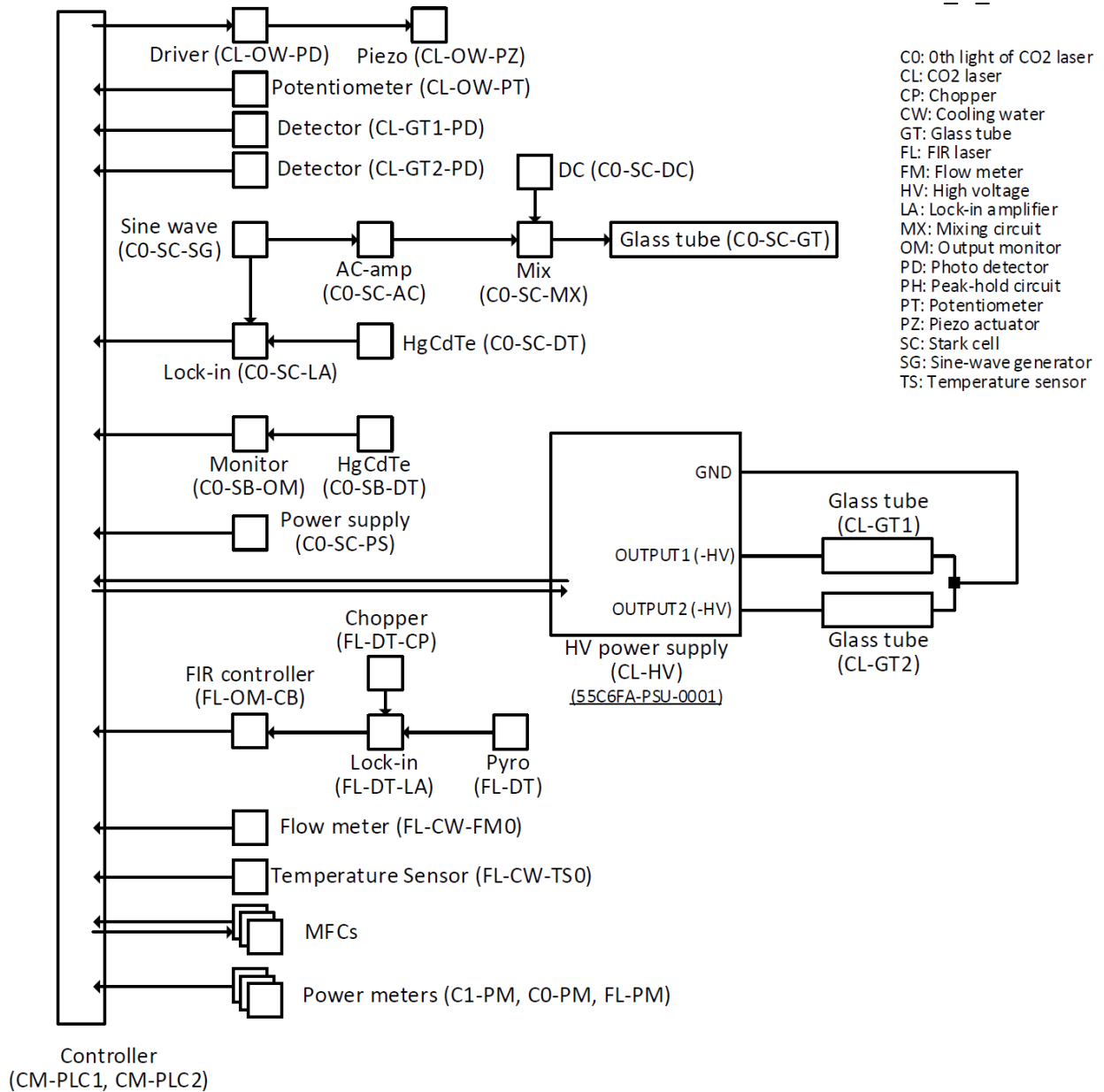


Figure 4 Diagram showing components associated with cooling water flow.
Grayed component (chiller) is beyond the scope of the FIR laser.



2.2. Control

Figure 7 shows the schematic of control signals of the FIR laser system. One fast controller manages three sets of the FIR laser system. Although the FIR laser system is a standalone system and operational without the fast controller, the fast controller is used in ITER to get/set process variables of the FIR laser via CA (Channel Access) of EPICS on PON and to start laser oscillation automatically.

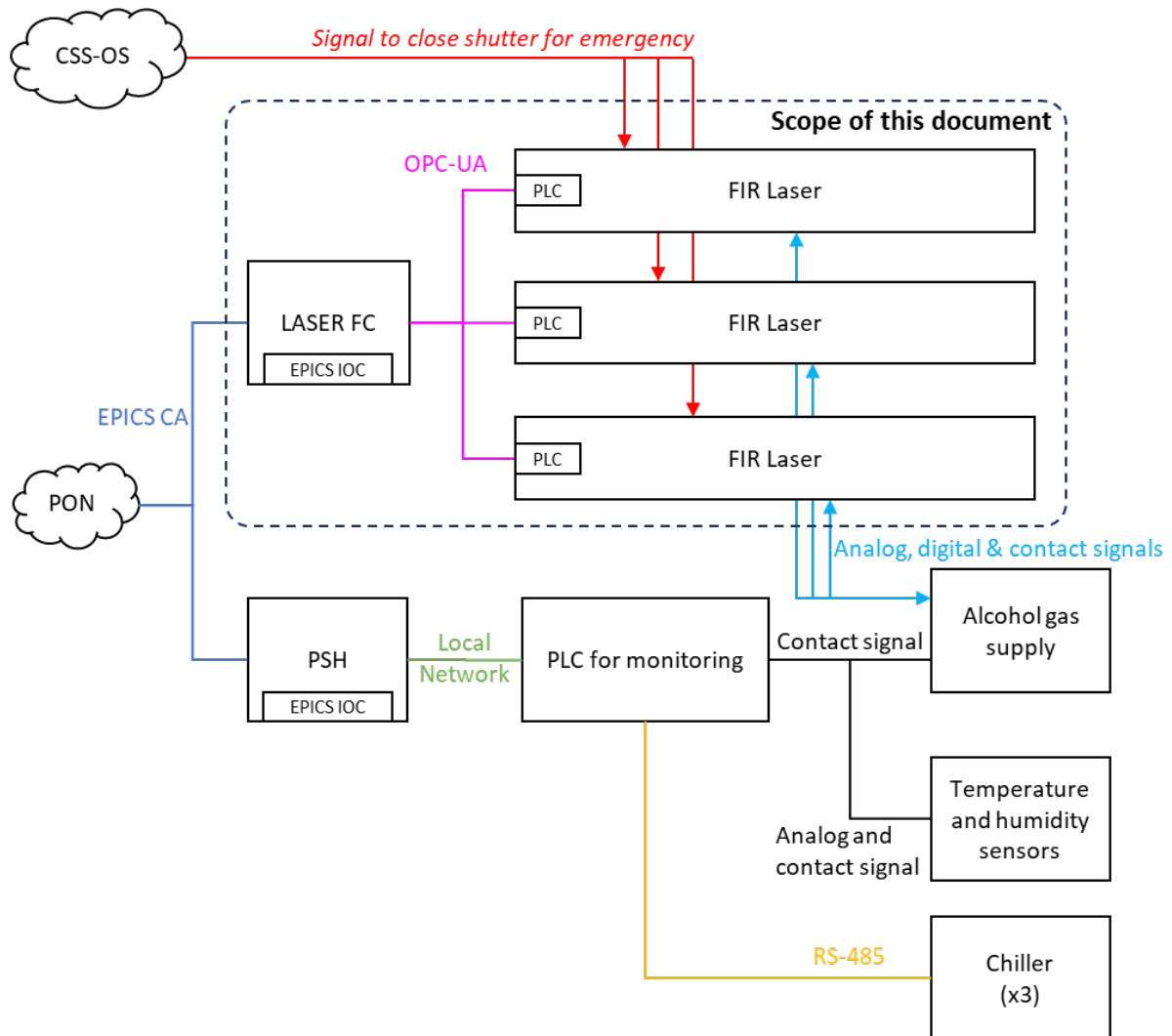


Figure 7 Schematic of control signals

3. Hardware Architecture of FIR Laser System

3.1. Diagrams, Component List and Drawings

Diagrams, a component list and mechanical drawings are given by Appendixes. Table 2 summarizes the information provided by each appendix.

Table 2 Overall hardware architecture

No.	Item	Reference
1	Optical layout diagram	Appendix I.
2	Vacuum system diagram	Appendix II.
3	Compressed air system diagram	Appendix III.
4	Cooling water system diagram	Appendix IV.
5	Control system diagram	Appendix V.
6	One line diagram	Appendix VI.
7	Circuit diagram	Appendix VII.
8	Control cabinet diagram	Appendix IIX.
9	Terminal block diagram	Appendix IX.
10	Component list	Appendix X.
11	Mechanical drawing	Appendix XI.

3.2. Connection between PLC for laser control and other devices

The FIR laser system uses the NX102-9000, an OMRON PLC, and an NX Series I/O unit connected to the NX-ECC203 to perform signal I/O for operating and monitoring the laser components. For safety I/O (requiring interlocking and reliability), the NX-SL3300 safety CPU unit and NX-series safety I/O units are used.

Figure 8 shows the physical connection between components and Figure 9 shows the protocol used for data exchange. Analog and contact signals are omitted here, and only communication connection lines are shown. The connections for all signal lines are shown in the one line diagrams (Appendix VI) and the circuit diagrams (Appendix VII).

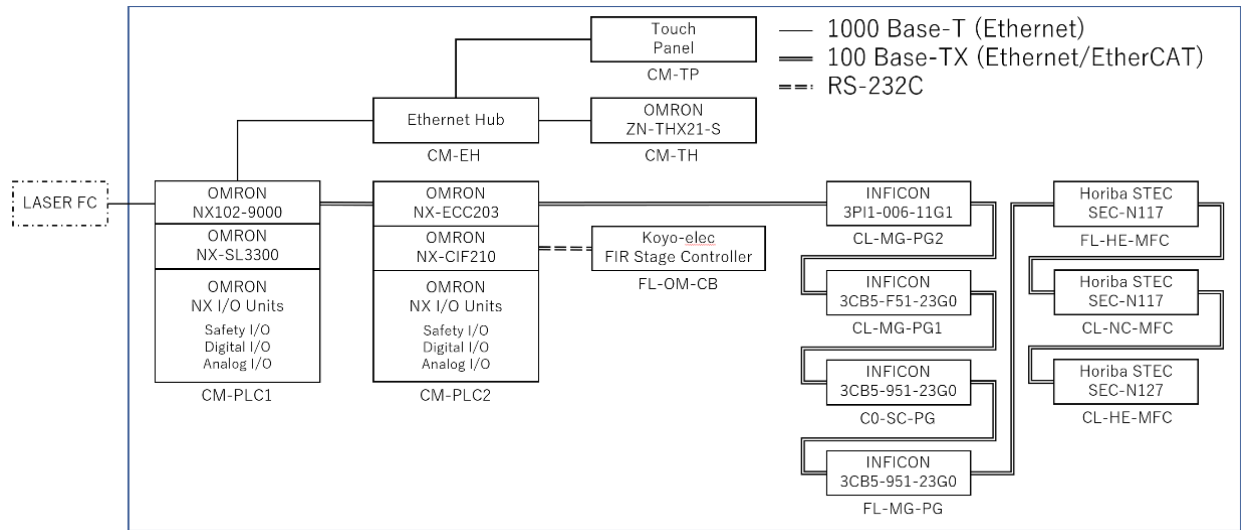


Figure 8 Schematic of the physical connection between PLC and other components

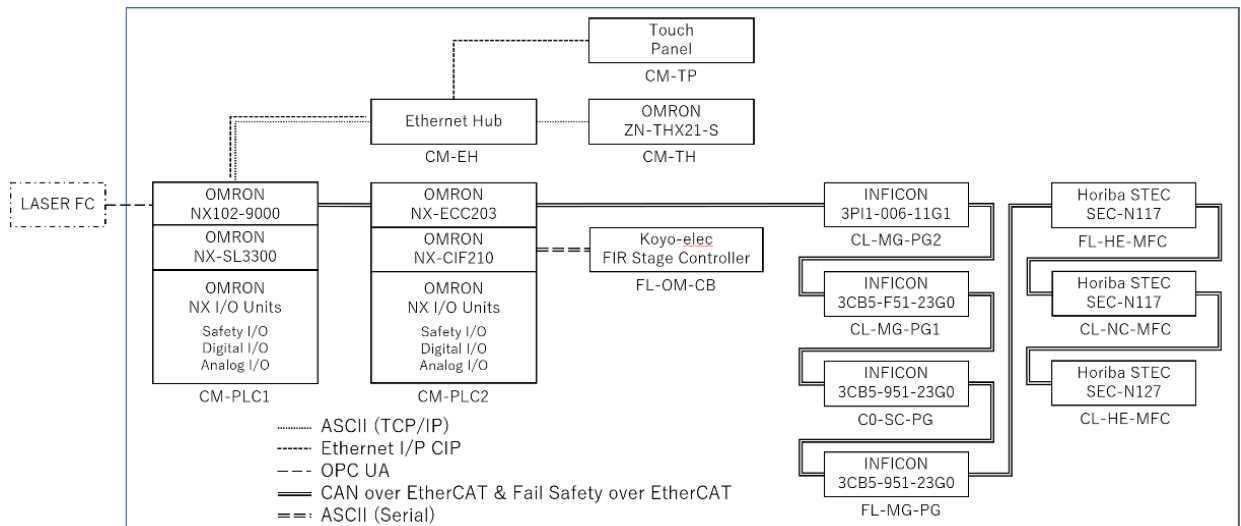


Figure 9 Communication protocol between PLC and other components

Table 3 describes the typical components of the FIR laser system shown in Figure 8 and Figure 9.

Table 3 Typical components of the FIR laser system shown in Figure 8 and Figure 9

Component	Component No.	Description
PCU CPU unit NX102-9000 (PLC (primary) for laser control)	A part of CM-PLC1	The NX102-9000 CPU unit has three RJ45 ports, one of which is dedicated for EtherCAT connection. The other two ports are standard Ethernet (and are compatible with the Ethernet I/P fieldbus), and it is possible to assign different segment IP addresses to the two ports. Thus, EtherCAT slave devices linked and daisy-chained to the CPU itself and devices connected to the Ethernet Hub for internal connection only (thermo-hygrometers and touch panels) are hidden from the outside world and not directly accessible. External devices such as the LASER FC are indirectly monitored and operated via the NX102-9000 main unit (See Figure 7).
Safety CPU unit NX-SL3300 and NX-series Safety I/O Unit	A part of CM-PLC1 and CM-PLC2	The NX-SL3300 safety CPU unit monitors and calculates safety I/O values. Data exchange and synchronization between the units is performed via Fail Safety over EtherCAT (FSoE).
NX-series I/O Unit	A part of CM-PLC1 and CM-PLC2	I/O units are used for input/output of analog signals and normal contact signals to/from laser control devices. The I/O unit is normally value-synchronized via CAN over EtherCAT (CoE).
EtherCAT Coupler NX-ECC203 (PLC (secondary) for laser control)	A part of CM-PLC2	Aggregates the values of I/O units connected as EtherCAT slave devices and communicates cyclically with the EtherCAT master, the NX102-9000.
Vacuum gauge (Gas piping inside laser system)	CL-MG-PG1 CL-MG-PG2 C0-SC-PG FL-MG-PG	The vacuum gauges are INFICON capacitance and Pirani gauges. The gauge body has a connector for EtherCAT, and the readout of the vacuum gauge values from the PLC is done by CoE. For start-up and adjustment of the laser, a display (and gauge power supply) will be provided to monitor the measured values without CCS.
Mass flow controller (Gas piping inside laser system)	FL-HE-MFC CL-NC-MFC CL-HE-MFC	The mass flow controller is installed under the laser stand and uses an N series EtherCAT-compatible model manufactured by HORIBA ESTECH.
Touch panel	CM-TP	A touch panel is provided for local control and display of various parameters. The touch panel is an OMRON NA5 series, and the NX102-9000 is connected to the touch panel via Ethernet, with Ethernet I/P Common Industrial Protocol (CIP). No complex processing (e.g., automatic ramp-up function) will be performed.
Temperature/Humidity sensor (Inside acrylic panel of laser system)	CM-TH	The temperature/humidity sensor acquires the temperature and relative humidity inside the acrylic panel of the laser system, and performs socket communication (ASCII command/response) with the PLC via a TCP/IP connection.
FIR stage controller	FL-OM-CB	The controller controls the stage of the moving mirror on the output side of the FIR laser and adjusts the resonator length. The communication protocol is ASCII. Serial communication parameters are described in Table 5.

3.3. IP address and Serial Communication Parameter

The IP addresses of the devices to be connected by Ethernet shall be as shown in Table 4. The NX102-9000, which is the CM-PLC1 CPU unit, has two Ethernet ports, one for connection to the LASER FC and the other for connection to the laser internal control system, and the communication is separated by separating the segments. The serial communication device setting is shown in Table 5.

Table 4 IP address list

Component	Component No.	IP address	Note
CPU unit (NX102-9000) Port#1	A part of CM-PLC1	To be given by a user.	
CPU unit (NX102-9000) Port#2	A part of CM-PLC1	192.168.250.1	Local address (Class C)
Touch panel (NA5-15W101S-V1)	CM-TP	192.168.250.2	Local address (Class C)
Temperature/Humidity sensor (ZN-THX21-S)	CM-TH	192.168.250.3	Local address (Class C)

Table 5 Serial communication setting list

Component	Component No.	Type	Baud rate	Data length	Parity	Stop bit
FIR stage controller	FL-OM-CB	RS232C	19200 bps	8 bit	None	1 bit

4. Software Architecture of FIR Laser System

4.1. PLC for Laser Control

4.1.1. Internal Processing

The internal processing of the PLC is described in the “PLC Internal Processing Flowchart” (Appendix XII). The development environment is SYSMAC STUDIO for OMRON NJ/NX series PLCs. The description language is ST (Structured Text), LD (Ladder) compliant with IEC 61131-3. The parameters of the components controlled by the Laser PLC can be set remotely via EPICS from the HMI of the MCR.

4.1.2. Interlock

Interlock is described in the "Interlock Condition Statement" (Appendix XIII). The development environment is SYSMAC STUDIO. Programs is coded by using FBD (Function Block Diagram) and PLCOpen Safety Function Block² in accordance with IEC 61131-3.

4.2. I/O Signal List

The PLC unit configuration and the signal types, conversion factors, and engineering units connected to each channel of the unit are described in the "I/O Signal List" (Appendix XIV). The bit mapping of OPC Unified Architecture (OPC UA) public variable contents and status (contact signals, PLC internal flags, etc.) packed in BYTE/WORD values are also described in this list. Conversion factors and units in the Signal column of the list are described in the following format for the minimum and maximum values of the measurement/operation range.

[PLC Analog I/O Unit value]: [Actual value to be measured/operated] [Engineering unit]

The coefficients listed in the Conversion Factor column are the coefficients for the conversion from values stored in PLC to the actual engineering units; the EGU column is the engineering units and is used for the EGU field in EPICS PV.

The alarm signal registers the EPICS PV of the alarm signal in this list to CSS Alarm. Since all the conditional judgments, etc., have already been calculated inside the PLC, no processing is required on the CSS Alarm side.

² <https://plcopen.org/technical-activities/safety>

4.3. Data exchange between Lase FC and PLC for laser control

The measurement data of the laser system is sent from the PLC for laser control to the LASER FC. EPICS IOC is built on LASER FC. This IOC runs as an OPC UA Client and serves as a bridge to EPICA CA, which is the communication protocol with the upper CODAC system. Therefore, it is necessary to map the OPC UA public variables published by NX102-9000 to the EPICS Database Record using the OPC UA module³. For example, implement the following:

- Structure variables will be implemented as `opcuaItem` record.
- If conversion of values, etc. is required, the conversion will be implemented in `calc/calcOut` record.
- Analog values will be implemented in `ai/ao` or `longin/longout`.
- Decomposition into/from multiple bit values is implemented in `mbbiDirect/mbboDirect` records.

The compatibility between OPC UA variables and EPICS Database Record variables is described in Chapter 3 and in Table 3-1 in [RD 1].

4.4. Building laser system I&C using SDD Editor

4.4.1. Overall Development Workflow

Manufacturer of the FIR laser shall develop LASER FC by using the SDD Editor according to Section 5.3-5.4 in [RD 2] and Chapter 4 in [RD 3]. Manufacturer of the FIR laser shall follow the development workflow described in Section 4.1 in [RD 3]. First, I&C project is created in the SDD Editor, and IOCs are defined in the project. Next, SDD configuration files are stored in the Central SDD DB via the Local SDD DB on the local mini-CODAC.

Name of each item for the building of the I&C project shall follow Section 4.3 in [RD 3]. The IOC Names used in the SDD Editor are in the following format.

<Plant System I&C>-<Control Unit><IOC Type>

For this laser system, Plant System I&C is "D1-J5", Control Unit is "PCF#" (#:1-3), and IOC Type is "PLC1".

4.4.2. Building EPICS IOCs

Manufacturer of the FIR laser shall use Maven Tools, SDD Translator and SDD Parser to generate IOC configuration files based on the EPICS IOC information defined by the SDD Editor. The EPICS Record definitions are defined either on the SDD Editor or by using the `VisualDCT`⁴ tool. If `VisualDCT` is used, the EPICS Record definition should be imported into SDD Editor using SDD Parser. In the record definition, manufacturer of the FIR laser may import a worksheet in the specified format described in Section 7.6 in [RD 5]. To implement what is created in the development environment into the execution environment, the IOC source code generated by SDD Translator is converted into an RPM package using Maven Tools. The IOC is implemented in LASER FC when the RPM package is installed in LASER FC, which is the execution environment. Manufacturer of the FIR laser shall follow Chapter 5 in [RD 3] for IOC generation,

³ <https://github.com/epics-modules/opcua>

⁴ `VisualDCT` is a tool for graphical visualization and editing of EPICS record definitions, and is commonly used by EPICS users and included in CODAC.

packaging, installation, and execution, as well as an example of using the Maven Tools. The Maven Tools is available from the SDD Editor GUI or console, and the IOC generation path is also described in Chapter 5 in [RD 3].

4.4.3. Functions and Variables

The various functions and variables are defined in the Enterprise Architect⁵ tool and can be imported into the SDD Editor using the EA2SDD tool. Manufacturer of the FIR laser shall follow the workflow described in chapter 5 in [RD 4].

4.4.4. EPICS Modules

The EPICS modules to be used are the EPICS Base, OPC UA modules and the modules that the OPC UA module depends on. These are included in the CCS, so there is no need to add specific modules to the CCS. For the version of CCS, the release at the time of production of the actual laser system will be used.

The setting items for the OPC UA module are listed in Table 6. By setting these connection information on the SDD Editor, it is automatically deployed in the `st.cmd` file, which is the startup script of the EPICS IOC.

Table 6 Connection setting information for OPC UA module

Item1	Item2	Description
Session	Name	PLC0
	Server URL * ¹	opc.tcp://xxx.xxx.xxx.xxx:4840/
	Debug	OFF
	Auto-Connect	YES
Subscription (1)	Name	FAST
	Interval	100
	Priority	-
	Debug	OFF
Subscription (1)	Name	SLOW
	Interval	500
	Priority	-
	Debug	OFF

*¹ The xxx.xxx.xxx.xxx.xxx part of the Server URL is the IP address of CM-PLC1 (NX102-9000) Port#1 (see Table 4).

⁵ <https://sparxsystems.com/>

4.5. User Interface (HMI)

4.5.1. Touch Panel for Local Control

The touch panel screen configuration consists of tabbed screens for each function. The screen is switched by tapping at the tabs.

Monitor Screen

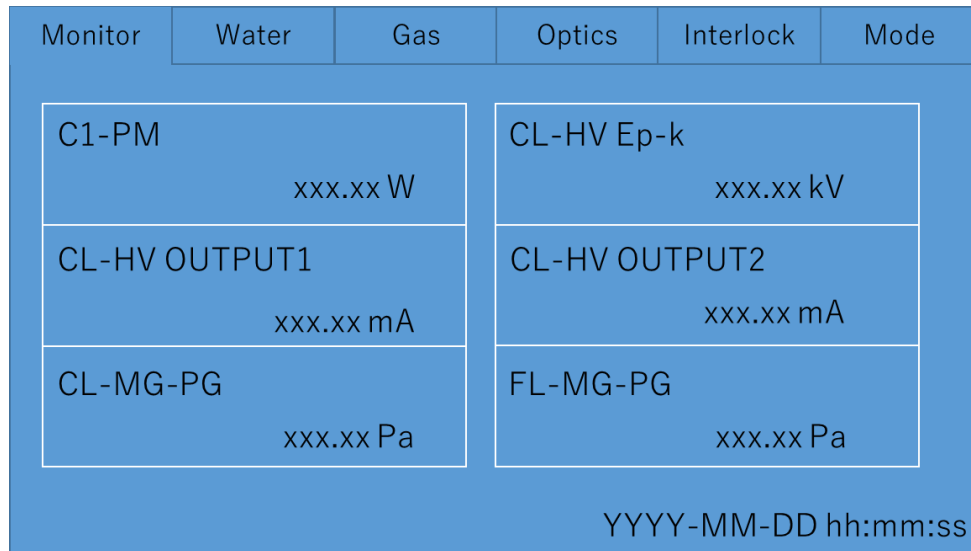


Figure 10 Monitor screen

Water System Screen

This screen displays the following information.

- Flowmeter and resistance thermometer values under the jurisdiction of the NX102-9000
- Temperature and relative humidity measured by the CM-TH installed inside the acrylic panel of the laser's base
- Dew point temperature obtained by calculation
- Detection status of the water leak sensor

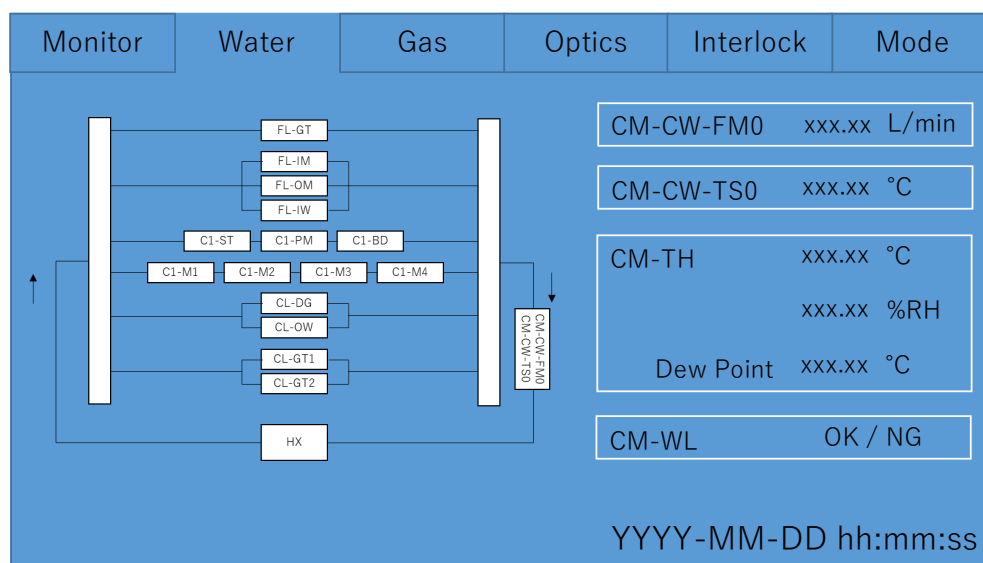


Figure 11 Water system screen

Gas System Screen

This screen displays the following information.

- Setpoint status of He and N₂CO₂ mixed gas supply side pressure (CL-HE-PG, CL-NC-PG)
- State of the open/close control output of the supply solenoid valve (CL-HE-AV, CL-MG-AV)
- Flow rate PV of mass flow controllers (CL-HE-MFC, CL-NC-MFC, FL-HE-MFC)
- PV of pressure gauges (CL-MG-PG1, CL-MG-PG2, C0-SC-PG, FL-MG-PG)
- PV of piezo valve (C0-SC-PV, FL-MG-PV)
- Operation status of pumps (CL-MG-VP, FL-MG-VP)

When control is local control, tapping a device opens a child screen to enable ON/OFF switching of PID control based on the valve, mass flow controller flow rate SV, piezo valve opening degree SV and piezo valve vacuum gauge value. The operational status of solenoid valves and pumps is displayed in green for Open/On/Normal and red for Close/Off/Error. The equipment number is displayed by placing the equipment number display button in the corner of the screen and overlaid only when the equipment number display button is enabled.

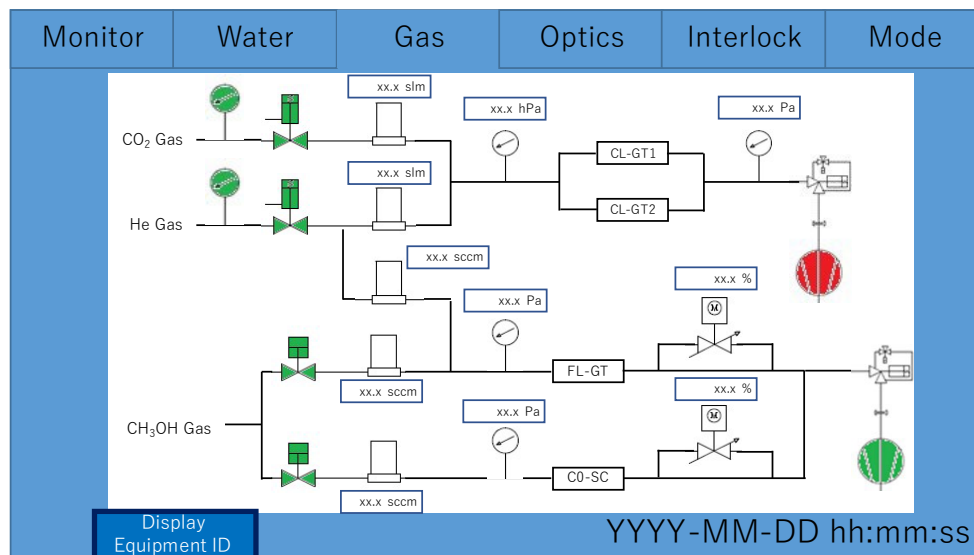


Figure 12 Gas system screen

Optical System Screen

This screen displays the following information.

- High-voltage power supply (CL-HV) operating status
- Insertion/evacuation status of movable mirror stages (C1-VL-M, C1-PM-M) into/from optical path
- Opening/closing state of shutter (C1-ST, FL-ST)
- Status of FIR stage controller (FL-OM-CB)
- Value of various detectors (CL-GT1-DT, CL-GT2-DT, C0-PM, C1-PM, FL-PM)

When control is local control, tapping a device opens a child screen for operation. The component under high voltage is displayed in yellow, and the open/close status is displayed in green (Open) and red (Close). the light path display is switched according to the status of CL-HV, C1-ST, C1-PM-M, and FL-ST.

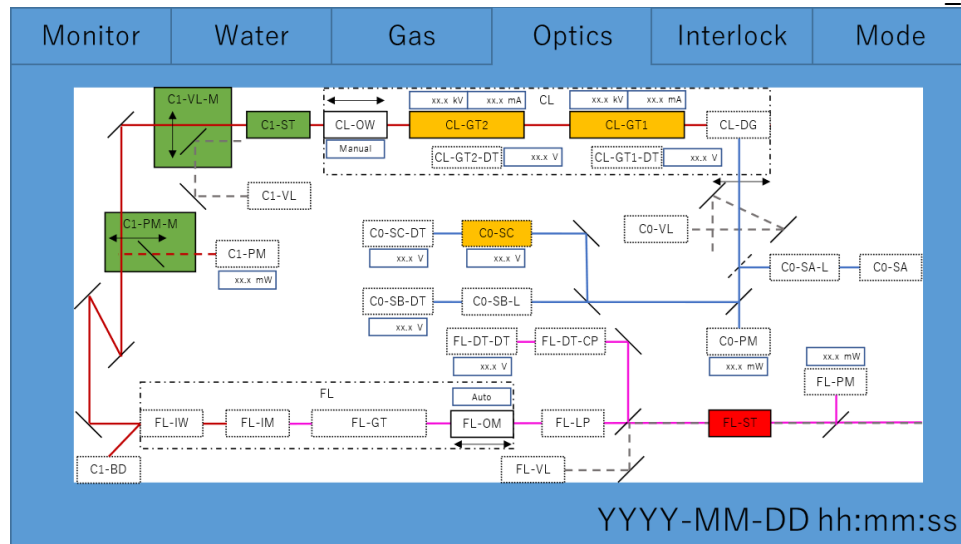


Figure 13 Optical system screen

Mode Switching Screen

This screen switches between local (device operation with CM-TP) and remote (operation with EPICS IOC/CSS). Switching between local and remote is not allowed while CL-HV voltage is being applied. When the user performs a mode switching operation, a confirmation screen is displayed to confirm that the user really wants to switch. If the user cancels on the confirmation screen, the switching is not performed.

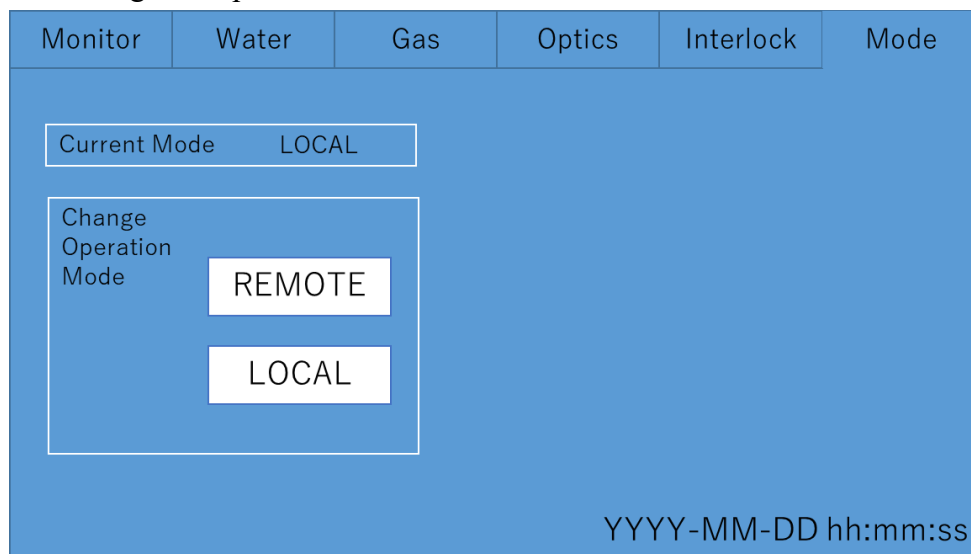


Figure 14 Mode switching screen

Interlock Status Screen

This screen displays the interlock status for each component (CL-HV, CL-NC-AV, CL-HE-AV, C1-ST, C1-VL-M, C1-PM-M, FL-ST) that is the interlock target. Also displays the status of contact signal input/output (CM-EI) with the monitoring PLC.

4.5.2. GUI for Remote Control

The prototype FIR laser uses a LabVIEW program to control each instrument via PLC. However, the FIR laser to be delivered to IO should use EPICS and CSS. This section provides the concepts of the screen that manufacturer of the FIR laser shall develop by using CSS. The concepts are based on the LabVIEW program of the prototype FIR laser. There are two panels that can be switched by tabs located at the top of the screen; one panel is for controlling and monitoring instruments and the other is for starting laser emissions automatically. The former panel is called “Main Screen” and the latter is called “Automatic Ramp-up Screen”.

Main Screen

In this panel, an operator can control the equipment of the FIR laser and can monitor the status of the equipment. By clicking buttons, the operator can change SVs of MFCs and SVs of the power supplies, can open/close valves and shutters, and can change the position of the output mirrors of the laser cavities.

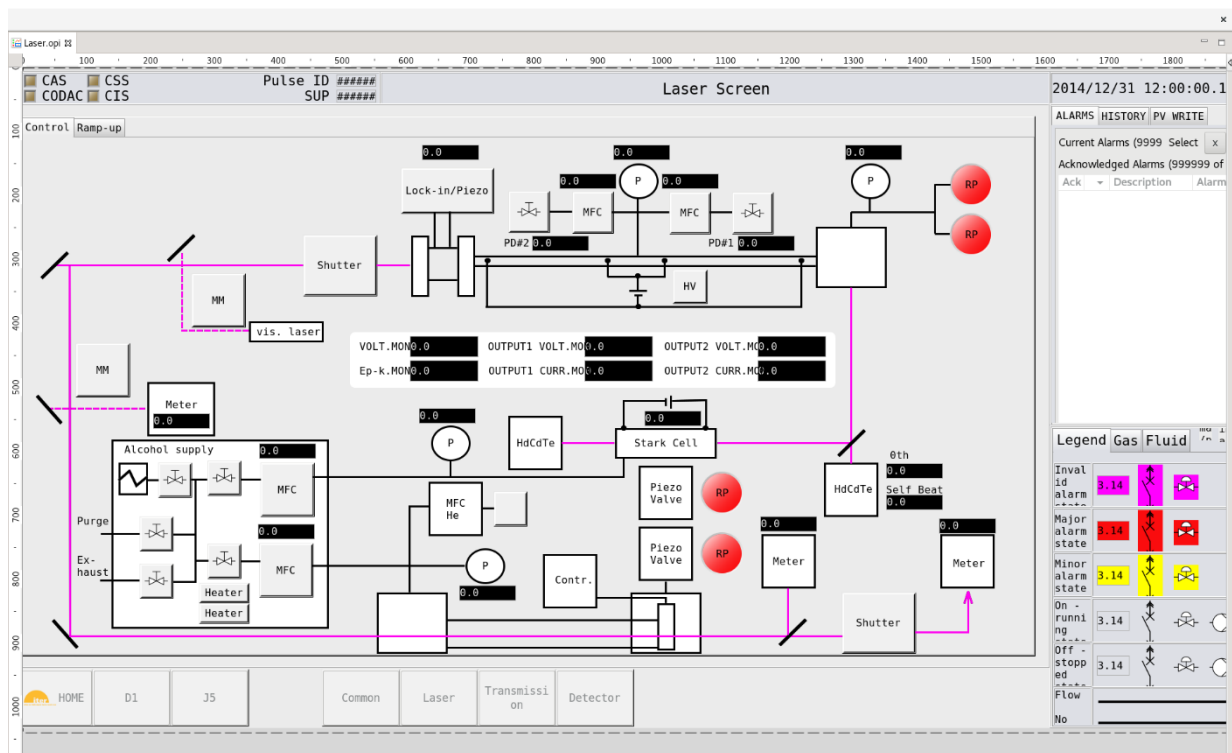


Figure 15 “Main Screen” for remote control of the FIR laser

Automatic Ramp-up Screen

In this panel, an operator can start laser emission automatically. So, this panel of the prototype LabVIEW program has a function of a sequencer to set up equipment according to the steps that the operator predetermines. The operator can change the operation step in this screen, can start and stop the sequencer in this screen and can monitor the status of the equipment in this screen during starting laser oscillation.

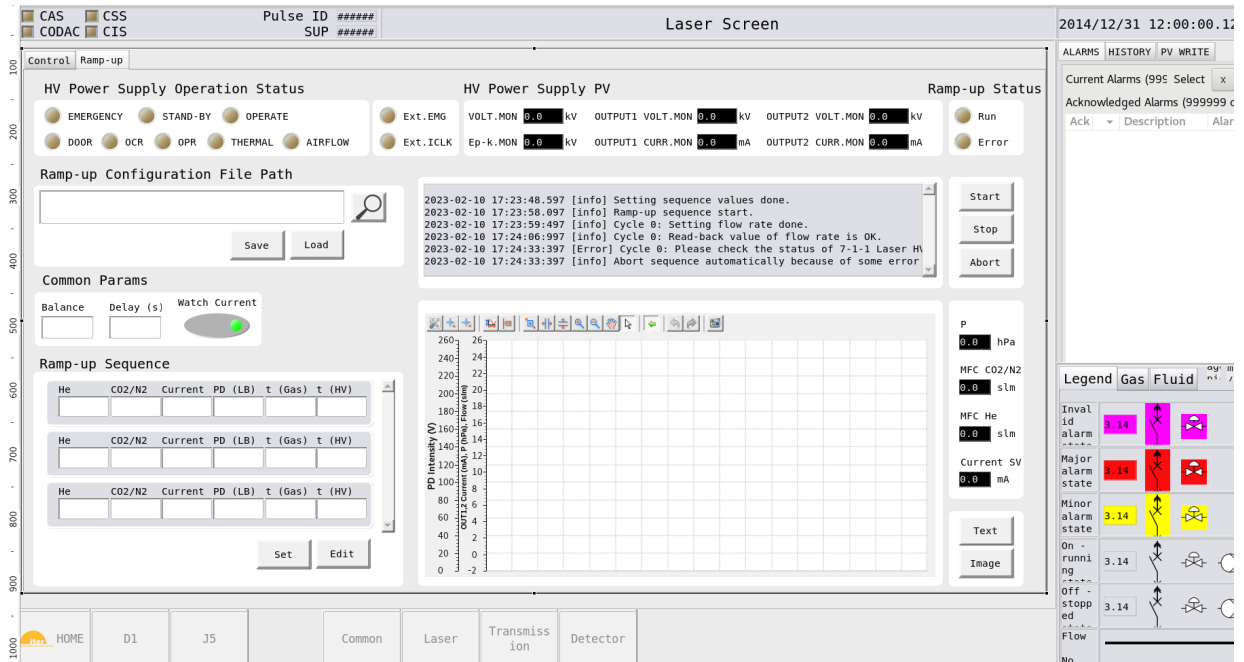
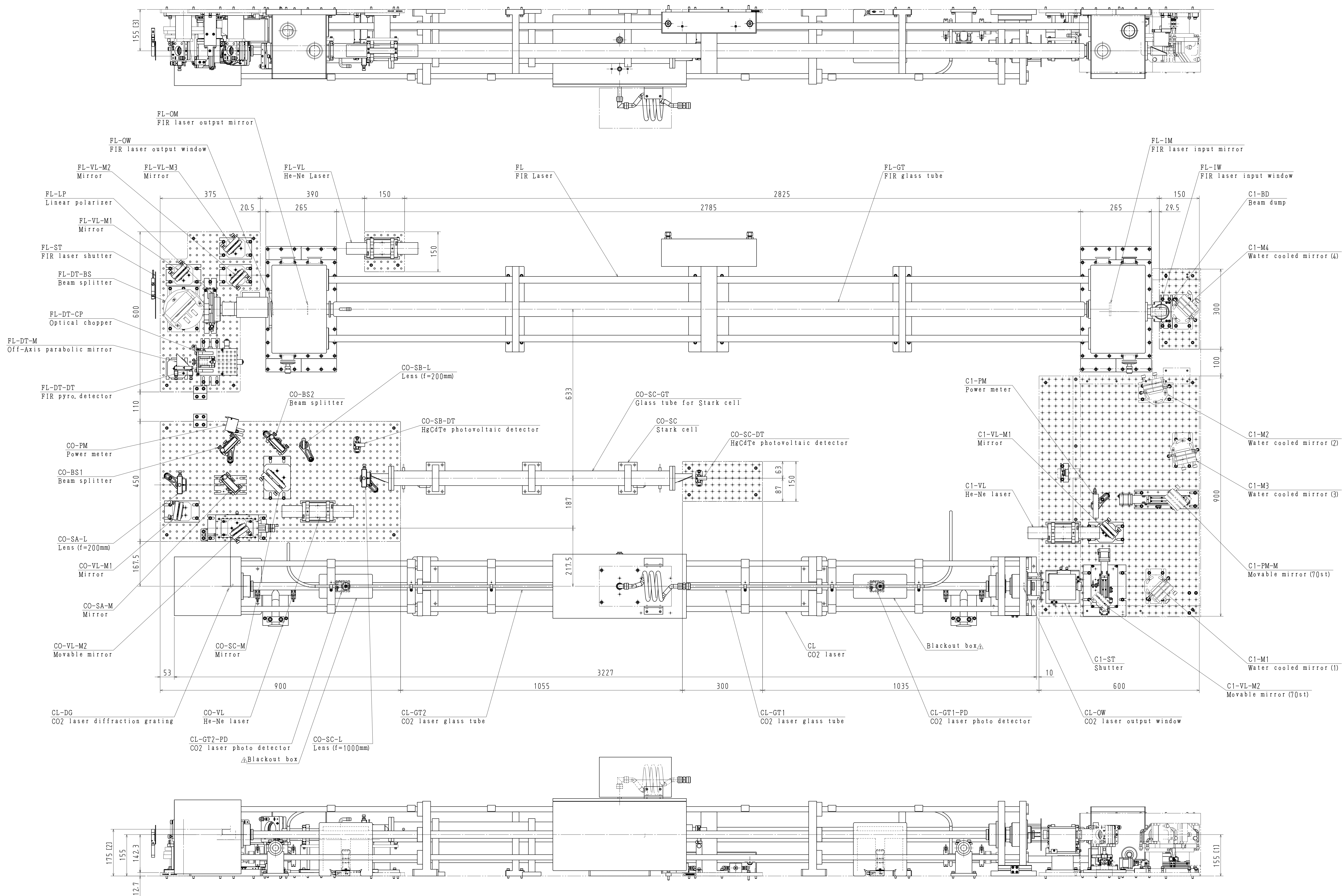


Figure 16 "Automatic Ramp-up Screen" for remote control of the FIR laser

APPENDIX I : Optical Layout Diagram



Note;

[1] Hight of CO₂ laser discharge tubes and 1st order output beam from the laser table surface. (not from a breadboard)

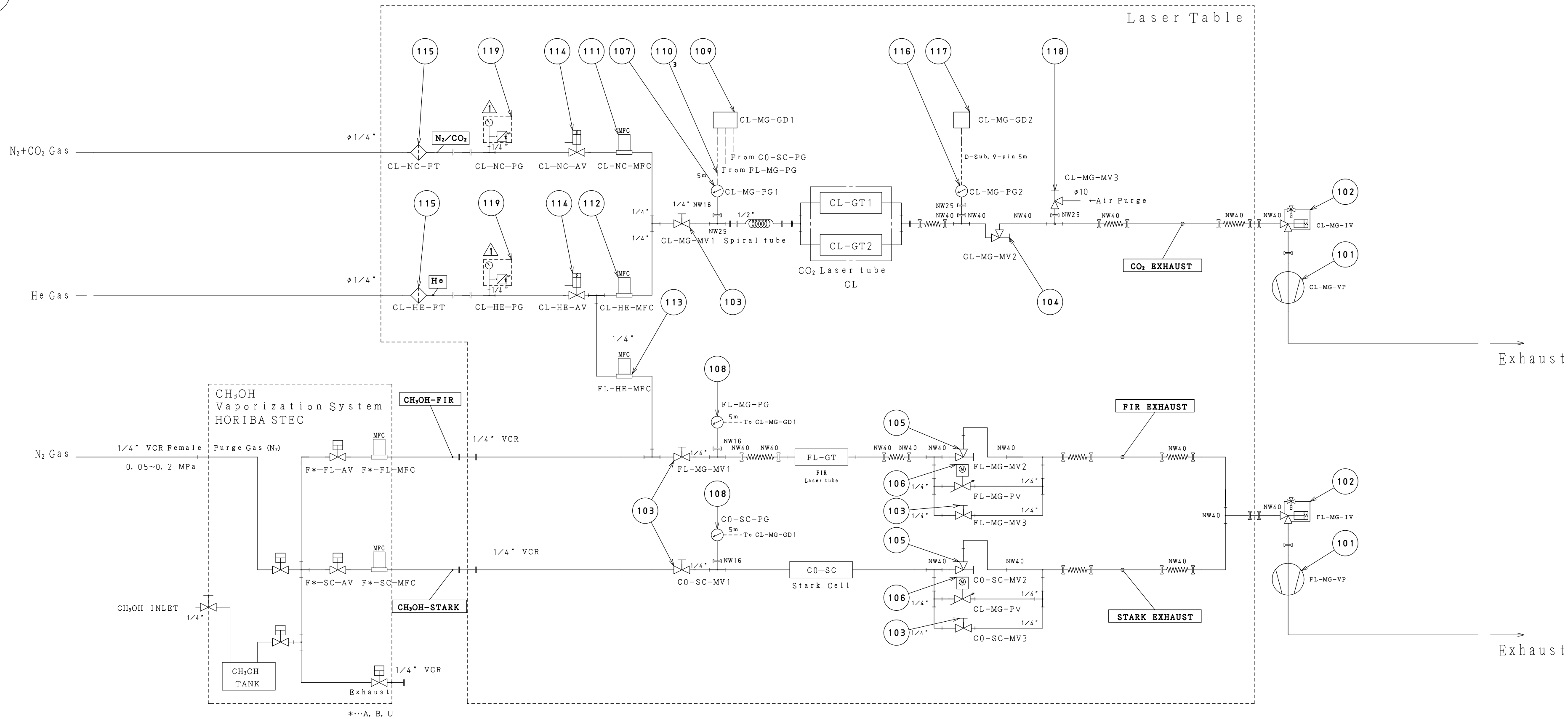
[2] Hight of 0th order output beam of CO₂ laser from the laser table surface. (not from a breadboard)

[3] Hight of FIR laser discharge tube and FIR laser beam from the laser table surface. (not from a breadboard)

[4] Specification of breadboards: Thickness is 12.7mm and thread pitch is 25mm

REV	MODIFICATION	DATE	MOD/BY	UNIT: mm	TITLE
1	Changing the Blackout box	20/04/2023			FIR Laser Optical Placement Diagram
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					
61					
62					
63					
64					
65					
66					
67					
68					
69					
70					
71					
72					
73					
74					
75					
76					
77					
78					
79					
80					
81					
82					
83					
84					
85					
86					
87					
88					
89					
90					
91					
92					
93					
94					
95					
96					
97					
98					
99					
100					

APPENDIX II : Vacuum System Diagram



55C600-DIA-0001

Annotation: Attach a name tag "letter" to the pipe with ring-chain

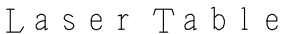
2	119		Z4204641	Pressure Switch (1/4SWG)	ISE20C-T-M-B2-W	SMC	
1	118		Z0501024	Inlet Valve NW25	951-7178	ANELVA	
1	117		Z0303089	Pirani Gauge Display	PGD500 G98-802	INFICON	
1	116		Z0303090	Pirani Gauge	3PI1-006-41G0	INFICON	
2	115		Z0506033	Filter	SS-4F-05	Swagelok	
2	114		Z0012281	Bellows Sealed Valve	SS-4BK-1C	Swagelok	
1	113		Z1301157	Mass Flow Controller He 10SCCM	SR0-H17MGM CSS, MR-MG-R01 10SCCM 4CRL, He	HORIBA STEC	
1	112		Z1301156	Mass Flow Controller He 15SLM	SR0-H17MGM CSS, MR-MG-07L 15SLM 4CRL, He	HORIBA STEC	
1	111		Z1301155	Mass Flow Controller N2 5SLM	SR0-H17MGM CSS, MR-MG-06 5SLM 4CRL, N2	HORIBA STEC	
3	110		Z0301043	Gauge Cable	398-541 5m	INFICON	
1	109		Z0301042	Gauge Controller	VCG503 G98-483	INFICON	
2	108		Z0301044	Capacitance Diaphragm Gauge	3CB5-961-23G0	INFICON	
1	107		Z0301041	Capacitance Diaphragm Gauge	3CB5-861-23G0	INFICON	
2	106		Z0509169	Piezo Valve	PV-A131-1/4"VCR	HORIBA STEC	
2	105		Z0502385	O-ring Sealed Valve	LV-NW40DX-1142450	Fuji Technology	
1	104		Z0502384	Bellows Sealed Valve	LEM-NW40DX-1352400	Fuji Technology	
5	103		Z0506127	Bellows Sealed Valve	SS-4H	Swagelok	
2	102		Z0402100	Isolation Valve	VIV408KA 208-230V AC/A50637512	Edwards	
2	101		Z0402099	Dry Roots Pump	nXR901	Edwards	

QTY	No.	SYMBOL	DWG No.	ITEM	PARTS NUMBER	MANUFAC.	REMARKS
△							
△							
△							
△	18/Feb/2023	Add Parts No.119					
REV	DATE	MODIFICATION	APPD/BY	MOD/BY			

RELEASED BY	TITLE
	FIR Laser Vacuum Diagram
SH No.	DWG No.
1/1	2KA-00056 △

APPENDIX III : Compressed Air System Diagram

1



"letter"

2	107		Z0016163	Plug	SFTS-1-PS	NBK	
1	106		Z4203309	Manifold	SS3YJ3-S42-02-M5-Q	SMC	
2	105		Z4203227	3-port Solenoid Valve	SYJ314-5GZD-Q	SMC	
1	104		Z4204172	Silencer	AN101-01	SMC	
2	103		Z0016920	Bulkhead Union	PM1/4	PISCO	
2	102		Z0016921	Tube Fitting Mini	POC1/4-M5M	PISCO	
1	101		Z0016151	Tube Fitting	PC1/4-01	PISCO	

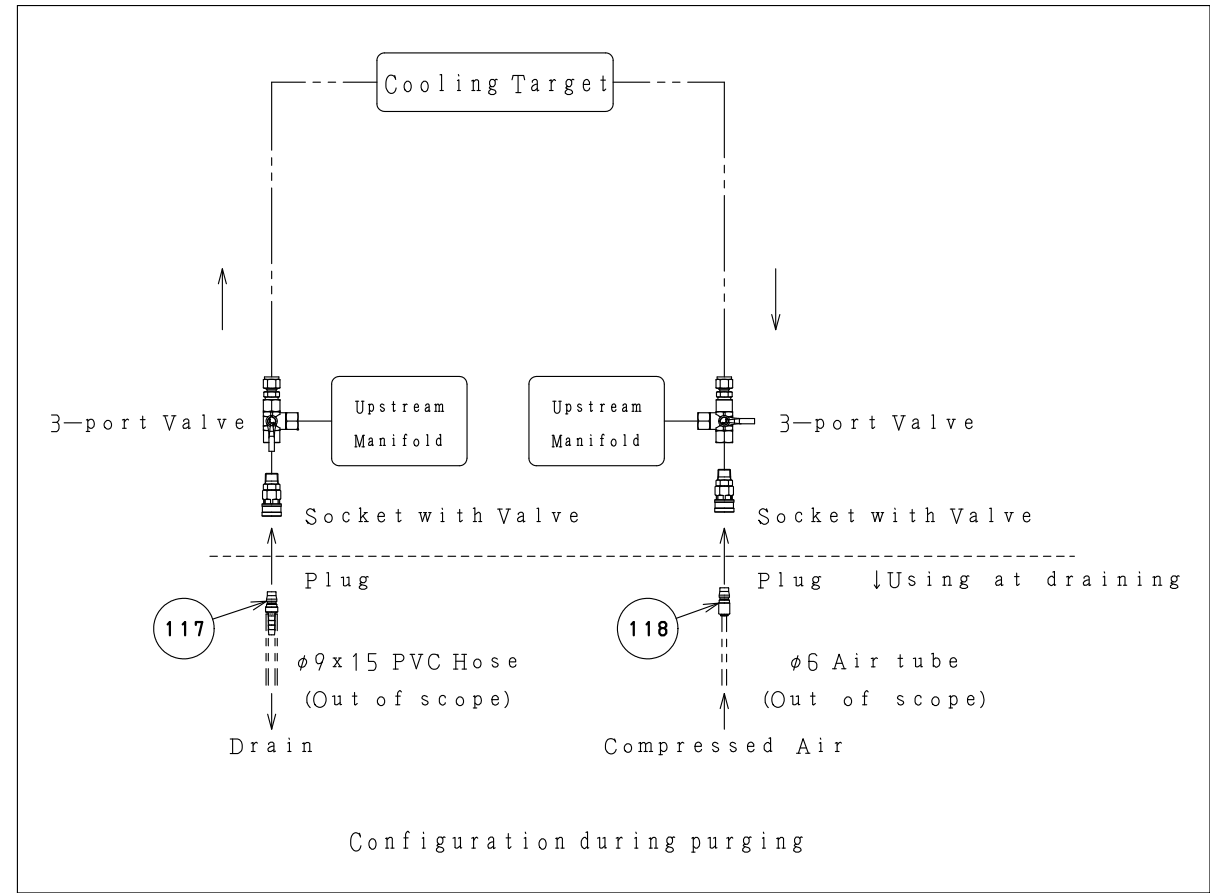
						RELEASED BY	TITLE	
							<i>FIR Laser Compressed air system Diagram</i>	
								
								
REV	DATE	MODIFICATION	APPD/BY	MOD/BY		SH No. 1/1	DWG No. 3KB-00080 	I C A

*FIR Laser
Compressed air system
Diagram*

DWG No. 3KB-00080 

APPENDIX IV : Cooling Water System Diagram

1

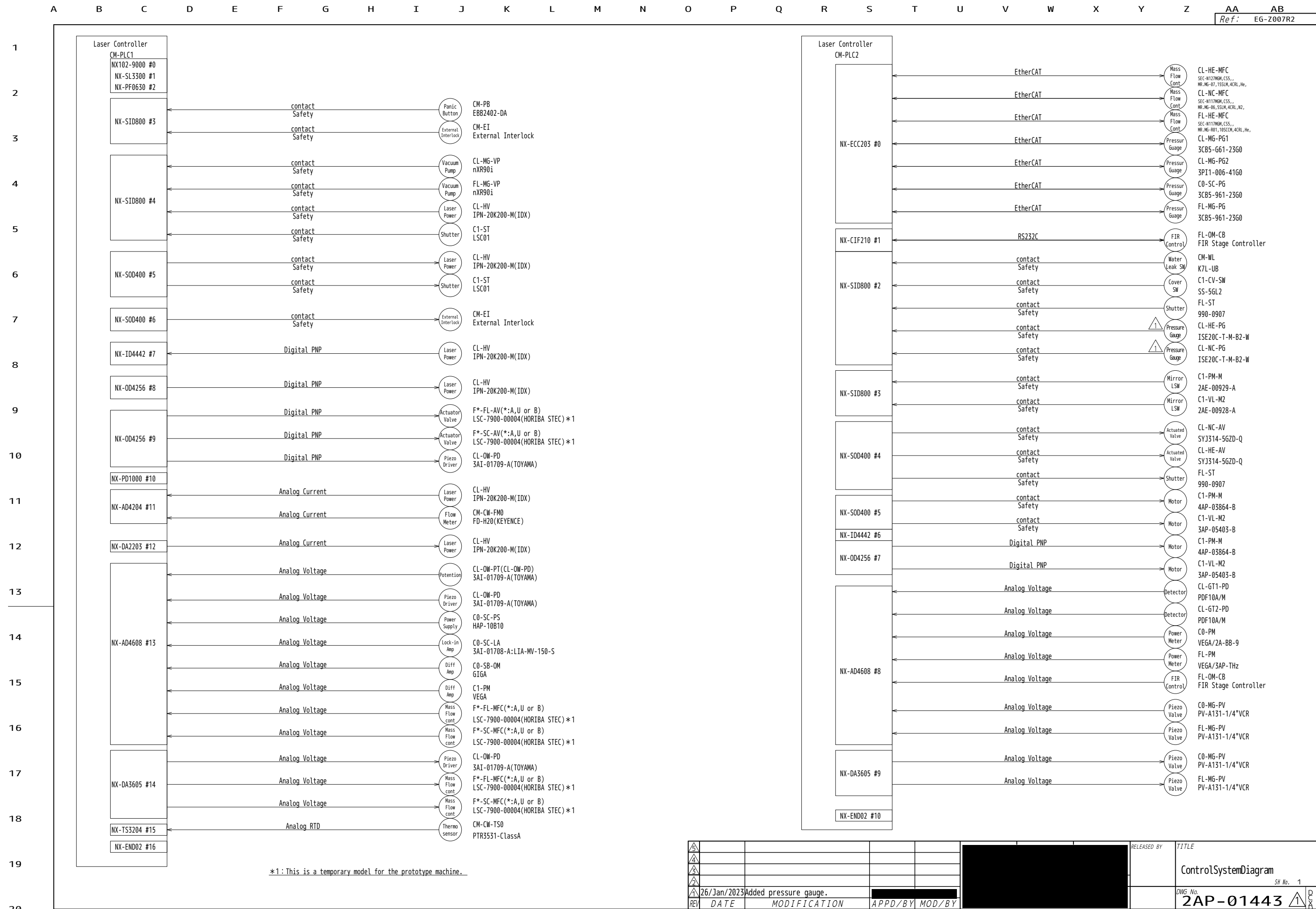


108 109 110

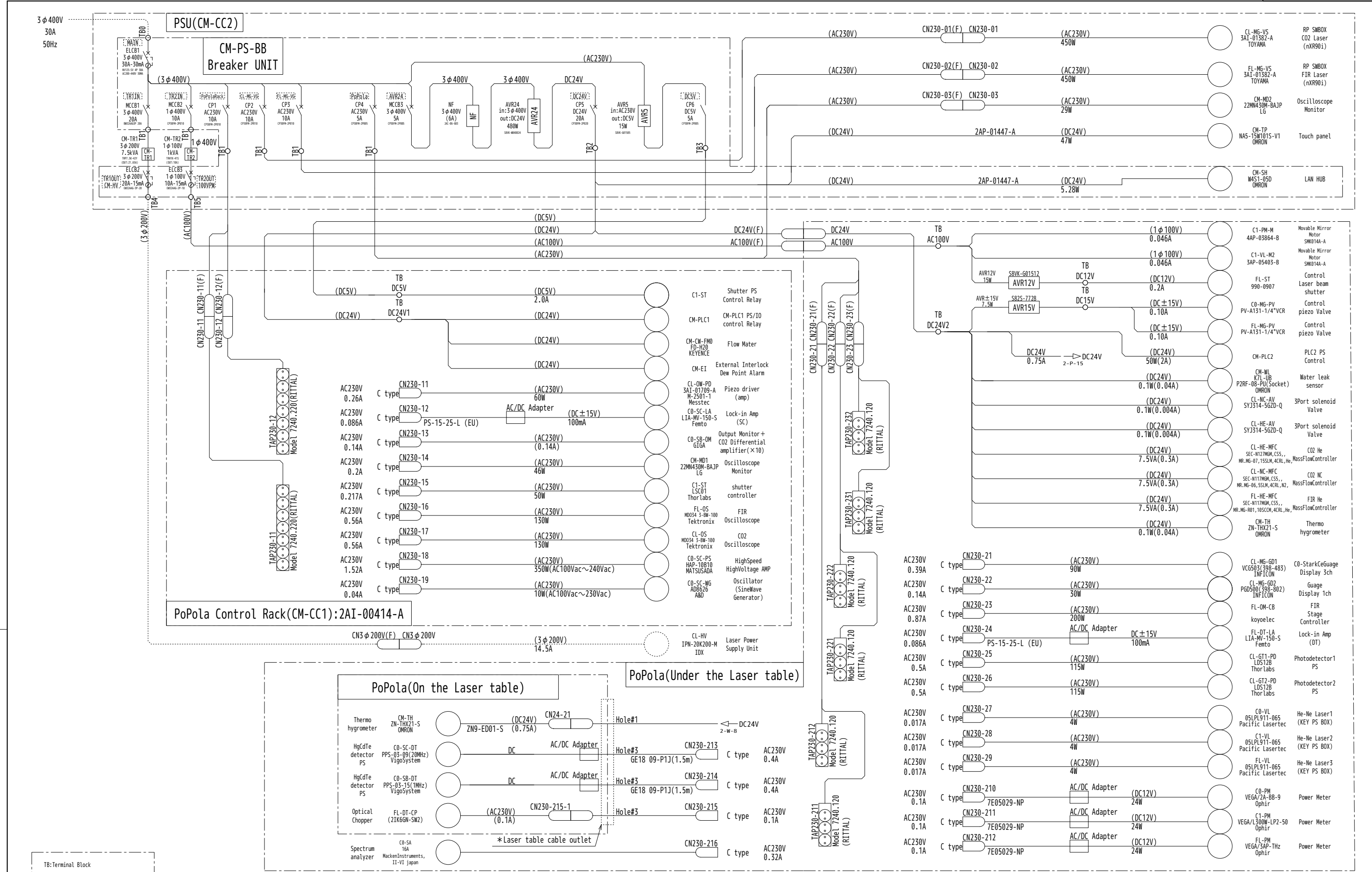
QTY	No.	SYMBOL	DWG No.	ITEM	PARTS NUMBER	MANUFAC.	REMARKS
						RELEASED BY	TITLE
							FIR Laser Water Cooling System Diagram
ON		APPD/BY	MOD/BY			SH No. 1/1	DWG No. 2KC-00056 

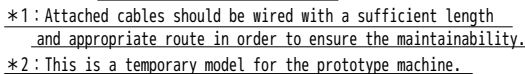
SH No. 1/1	DWG No. 2KC-00056 	ICAD
---------------	--	------

APPENDIX V : Control System Diagram

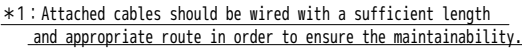


APPENDIX VI : One Line Diagram



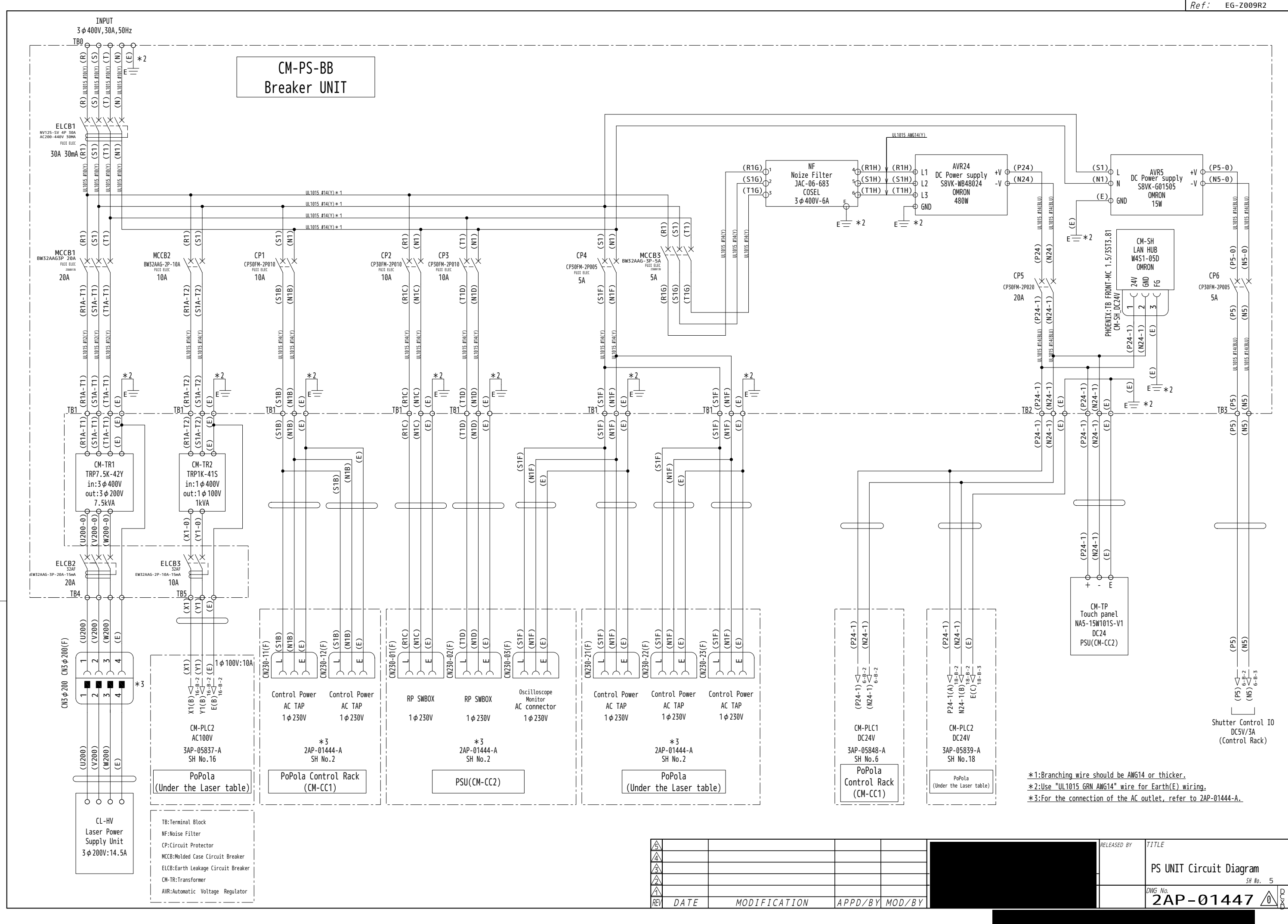


△					[REDACTED]	RELEASED BY	TITLE
△							Signal Cabling (PLC1)
△							SH No. 3
△							DWG No.
△							2AP-01445 △
REV	DATE	MODIFICATION	APPD/BY	MOD/BY			



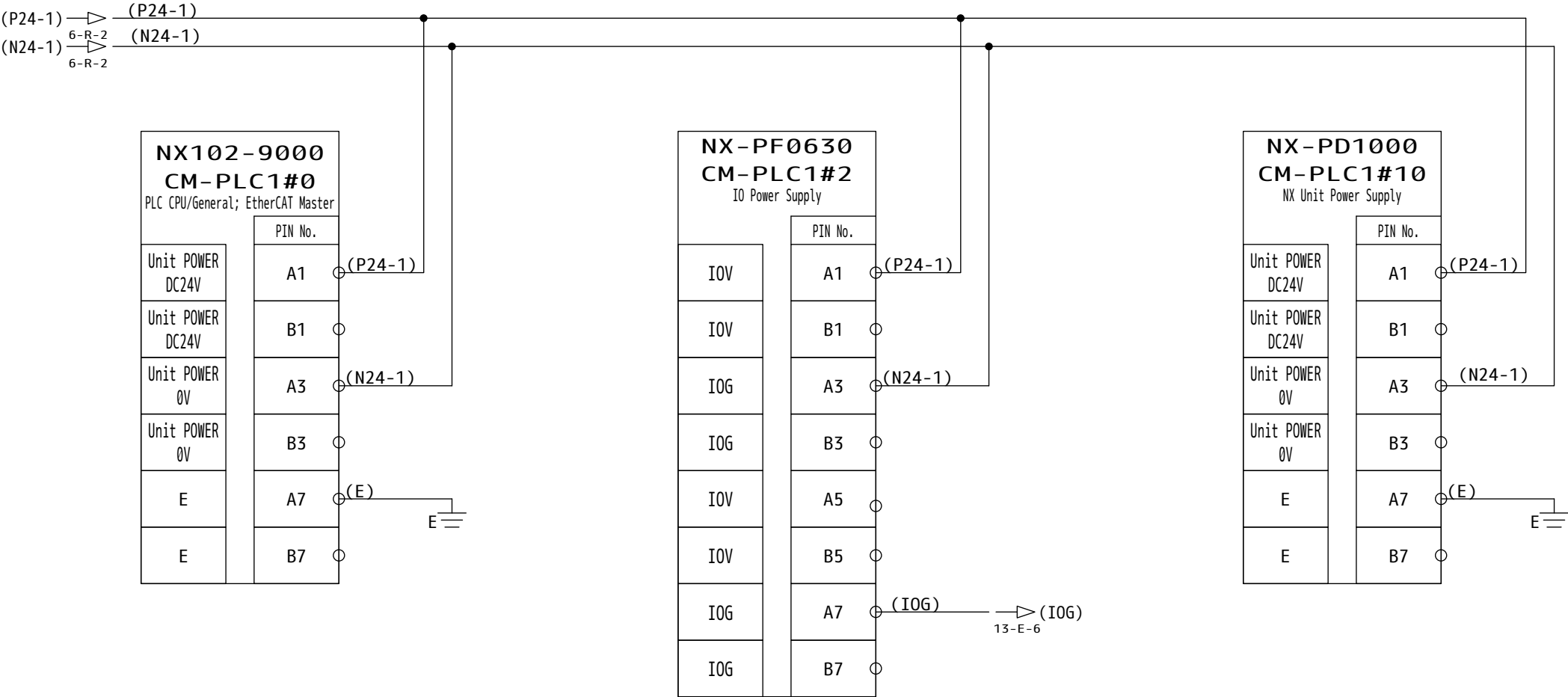
4.

APPENDIX VII : Circuit Diagram





CM-PLC1



* : Crimp the wire ends with DIN 46228-4 ferrule.
* : Use "UL1007 BL AWG18" wire for DC24V wiring.
* : DC24V power wiring is branched from the terminal block (TBDC24V1).
* : Use "UL1007 GRN AWG18" wire for Earth(E) wiring.

5						RELEASED BY	TITLE
4							PLC1#0 / 2 / 10(DC24V)
3							SH No. 7
2							DWG No.
1							3AP-05847
REV	DATE	MODIFICATION	APPD/BY	MOD/BY			

1

2

3

4

5

6

7

8

9

10

11

12

13

14

CM-PLC1

NX-SID800 CM-PLC1#3 8ch Safety Input		
Signal	I/O	PIN No.
CM-PB-SW1 Emergency STOP dual contact1/2	Si0	A1
CM-PB-SW1 Emergency STOP dual contact1/2	T0	A2
CM-PB-SW2 Reset	Si2	A3
CM-PB-SW2 Reset	T0	A4
CM-EI External Interlock	Si4	A5
CM-EI External Interlock	T0	A6
	Si6	A7
	T0	A8
CM-PB-SW1 Emergency STOP dual contact2/2	Si1	B1
CM-PB-SW1 Emergency STOP dual contact2/2	T1	B2
CM-PB-SW3 Lock/Unlock	Si3	B3
CM-PB-SW3 Lock/Unlock	T1	B4
	Si5	B5
	T1	B6
	Si7	B7
	T1	B8

CM-PB_P

CM-PB_1

CM-PB
Panic
Button BOX
3AI-01381-A
CM-PB-SW1

(Reset)
CM-PB-SW2

CM-PB-SW1

(EMC IL)
CM-PB-SW3

CM-PLC1

NX-SID800 CM-PLC1#4 8ch Safety Input		
Signal	I/O	PIN No.
CL-MG-VP Contacts on Pump	Si0	A1
CL-MG-VP Contacts on Pump	T0	A2
CL-HV EMERGENCY	Si2	A3
CL-HV EMERGENCY	T0	A4
C1-ST C1 Shutter Closed	Si4	A5
	T0	A6
	Si6	A7
	T0	A8
FL-MG-VP Contacts on Pump	Si1	B1
FL-MG-VP Contacts on Pump	T1	B2
C1-ST C1 Shutter Opened	Si3	B3
	T1	B4
	Si5	B5
	T1	B6
	Si7	B7
	T1	B8

CL-MG-VP_Cont
XM2Z-0011,XM3D-0921

CL-MG-VP_Cont

CL-MG-VP_Cont Dsub9P

CL-HV_IO

CL-HV_IO

CL-HV_IO Dsub37P

CN2

(EMC)

CL-HV
Laser Power
Supply Unit
IPN-20K200-M

FL-MG-VP_Cont
XM3D-0921

FL-MG-VP_Cont

FL-MG-VP_Cont Dsub9P

FL-MG-VP
nXR90i

* : Crimp the wire ends with DIN 46228-4 ferrule.

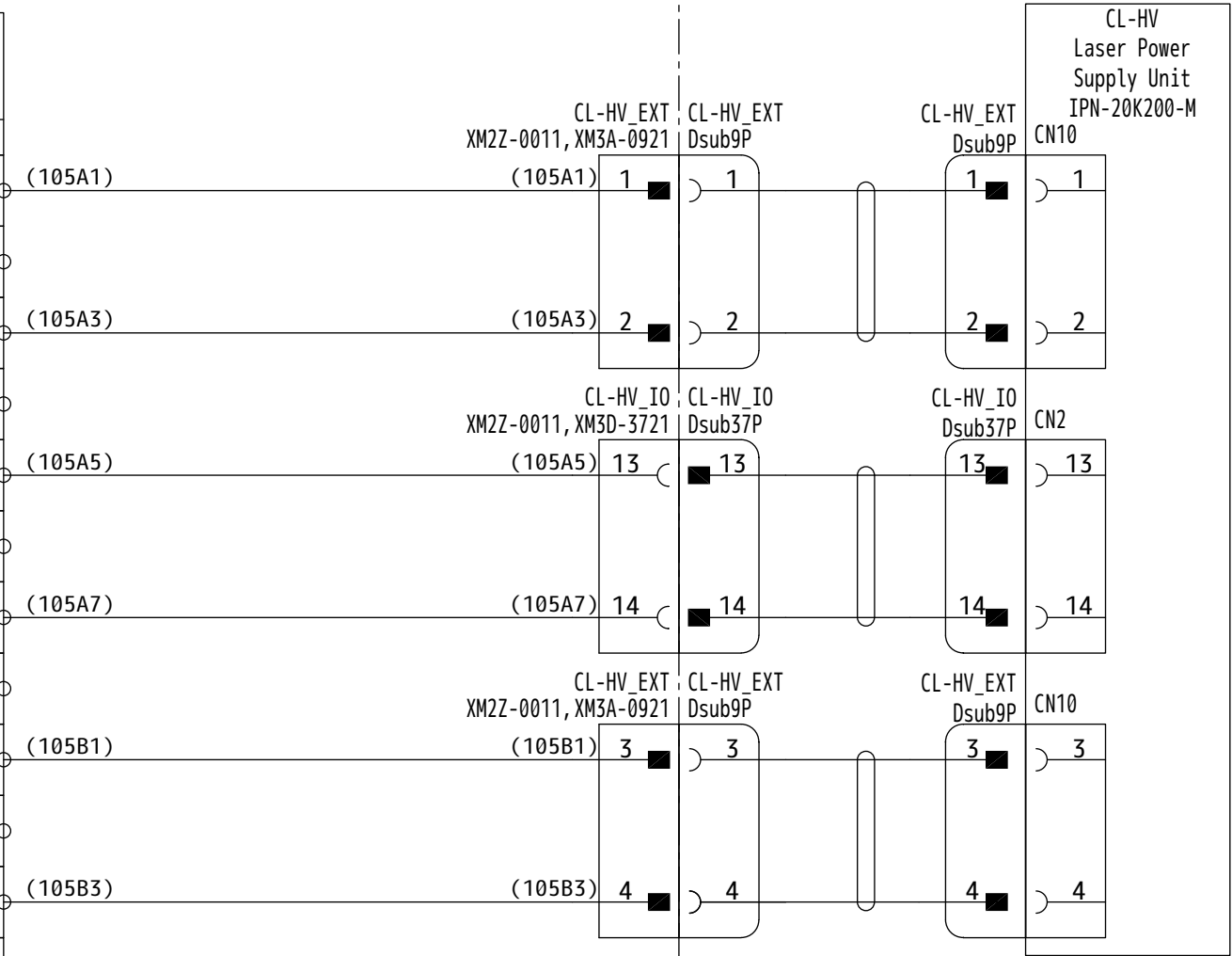
* : Use "UL1007 BL AWG22" for the electric wires.

5						RELEASED BY	TITLE
4							
3							
2							
1							
REV	DATE	MODIFICATION	APPD/BY	MOD/BY			
							PLC1#3/4(SID800/SID800)
							SH No. 8
							DWG No. 3AP-05849

PCB

CM-PLC1

NX-SOD400 CM-PLC1#5 4ch Safety Output		
Signal	I/O	PIN No.
CL-HV EXT. INTERLOCK	So0	A1
		A2
CL-HV EXT. INTERLOCK	IOG	A3
		A4
CL-HV RESET	So2	A5
		A6
CL-HV RESET	IOG	A7
		A8
CL-HV EXT. EMERGENCY	So1	B1
		B2
CL-HV EXT. EMERGENCY	IOG	B3
		B4
C1-ST C1 Shutter Open/Close	So3	B5
		B6
C1-ST C1 Shutter Open/Close	IOG	B7
		B8



* : Crimp the wire ends with DIN 46228-4 ferrule.
* : Use "UL1007 BL AWG22" for the electric wires.

5						RELEASED BY	TITLE
4							
3							
2							
1							
REV	DATE	MODIFICATION	APPD/BY	MOD/BY			

PLC1#5(SOD400)

SH No. 9

DWG No.
3AP-05850



PC

CM-PLC1

NX-SOD400 CM-PLC1#6 4ch Safety Output		
Signal	I/O	PIN No.
CM-EI Dew Point Alarm	So0	A1
		A2
CM-EI Dew Point Alarm	IOG	A3
		A4
	So2	A5
		A6
	IOG	A7
		A8
	So1	B1
		B2
	IOG	B3
		B4
	So3	B5
		B6
	IOG	B7
		B8

(106A1) 6-L-4 (106A1)

(106A2) 6-L-4 (106A2)

CM-PLC1

NX-ID4442 CM-PLC1#7 8ch Digital Input (PNP)		
Signal	I/O	PIN No.
CL-HV STAND-BY	IN0	A1
CL-HV STAND-BY	IOV0	A2
CL-HV DOOR	IN2	A3
CL-HV DOOR	IOV2	A4
CL-HV OPR	IN4	A5
CL-HV OPR	IOV4	A6
CL-HV AIRFLOW	IN6	A7
CL-HV AIRFLOW	IOV6	A8
CL-HV OPERATE	IN1	B1
CL-HV OPERATE	IOV1	B2
CL-HV OCR	IN3	B3
CL-HV OCR	IOV3	B4
CL-HV THERMAL	IN5	B5
CL-HV THERMAL	IOV5	B6
	IN7	B7
	IOV7	B8

CL-HV_IO
XM3D-3721
XM2Z-0011

CL-HV_IO
Dsub37P

CL-HV_IO
Dsub37P

CL-HV
Laser Power
Supply Unit
IPN-20K200-M
CN2

* : Crimp the wire ends with DIN 46228-4 ferrule.

* : Use "UL1007 BL AWG22" for the electric wires.

5						RELEASED BY	TITLE
4							
3							PLC1#6 / 7(SOD400 / ID4442)
2							SH No. 1 0
1							DWG No.
REV	DATE	MODIFICATION	APPD/BY	MOD/BY			3AP-05851 0

CM-PLC1

NX-OD4256 CM-PLC1#8 8ch Digital Output (PNP)		
Signal	I/O	PIN No.
CL-HV STAND-BY ON	OUT0	A1
CL-HV STAND-BY ON	I0G0	A2
CL-HV OPERATE ON	OUT2	A3
CL-HV OPERATE ON	I0G2	A4
CL-HV BUZZER ON	OUT4	A5
CL-HV BUZZER ON	I0G4	A6
	OUT6	A7
	I0G6	A8
CL-HV STAND-BY OFF	OUT1	B1
CL-HV STAND-BY OFF	I0G1	B2
CL-HV OPERATE OFF	OUT3	B3
CL-HV OPERATE OFF	I0G3	B4
CL-HV BUZZER OFF	OUT5	B5
CL-HV BUZZER OFF	I0G5	B6
	OUT7	B7
	I0G7	B8

CL-HV_I0
XM3D-3721
XM2Z-0011

CL-HV_I0
Dsub37P

CL-HV_I0
Dsub37P

CL-HV
Laser Power
Supply Unit
IPN-20K200-M
CN2

* : Crimp the wire ends with DIN 46228-4 ferrule.
* : Use "UL1007 BL AWG22" for the electric wires.

5				
4				
3				
2				
1				
REV	DATE	MODIFICATION	APPD/BY	MOD/BY

RELEASED BY

TITLE

PLC1#8(OD4256)

SH No. 1 1

DWG No.

3AP-05852

0

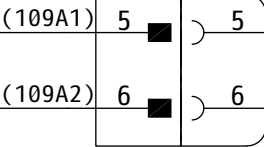
PC

CM-PLC1

NX-OD4256 CM-PLC1#9 8ch Digital Output (PNP)		
Signal	I/O	PIN No.
F*-FL-AV Actuated Valve	OUT0	A1
F*-FL-AV Actuated Valve	I0G0	A2
CL-OW-PD LOCAL CONTROL FLAG	OUT2	A3
CL-OW-PD LOCAL CONTROL FLAG	I0G2	A4
	OUT4	A5
	I0G4	A6
	OUT6	A7
	I0G6	A8
F*-SC-AV Actuated Valve	OUT1	B1
F*-SC-AV Actuated Valve	I0G1	B2
	OUT3	B3
	I0G3	B4
	OUT5	B5
	I0G5	B6
	OUT7	B7
	I0G7	B8

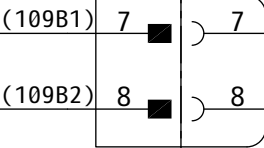
F*-FL-AV/F*-SC-AV
XM2Z-0011, XM3A-1521

F*-FL-AV/F*-SC-AV(*:A,U or B)
Dsub15P

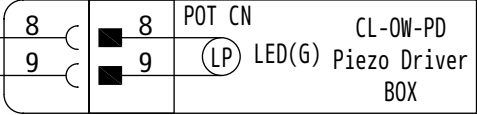


F*-FL-AV/F*-SC-AV
XM2Z-0011, XM3A-1521

F*-FL-AV/F*-SC-AV(*:A,U or B)
Dsub15P



CL-OW-PD_Din P



CH3OH
Vaporizer
LSC-7900-00004(*1)

F*-FL-AV(*:A,U or B)

5 AV-3 OPEN

EXT AV

6 AV-3 OPEN COM

F*-SC-AV(*:A,U or B)

7 AV-4 OPEN

EXT AV

8 AV-4 OPEN COM

55C600-DIA-0001

*1: This is a temporary model for the prototype machine.

* : Crimp the wire ends with DIN 46228-4 ferrule.

* : Use "UL1007 BL AWG22" for the electric wires.

5						RELEASED BY	TITLE
4							
3							
2							
1							
REV	DATE	MODIFICATION	APPD/BY	MOD/BY			
							PLC1#9(OD4256)
							SH No. 1 2
							DWG No. 3AP-05853

CM-PLC1

NX-AD4204

CM-PLC1#11

8ch Analog Current Input 4-20mA 1/8000

Signal	I/O	PIN No.
CL-HV VOLT.MON (0: 0V, 8000: 25kV)	Input1+	A1
CL-HV VOLT.MON (0: 0V, 8000: 25kV)	Input1-	A2
CL-HV VOLT.MON OUTPUT2 (0: 0V, 8000: 25kV)	Input3+	A3
CL-HV VOLT.MON OUTPUT2 (0: 0V, 8000: 25kV)	Input3-	A4
CL-HV CURR.MON OUTPUT2 (0: 0mA, 8000: 150mA)	Input5+	A5
CL-HV CURR.MON OUTPUT2 (0: 0mA, 8000: 150mA)	Input5-	A6
CM-QW-FMO Flow rate (0: 0L/min, 8000: 200L/min)	Input7+	A7
CM-QW-FMO Flow rate (0: 0L/min, 8000: 200L/min)	Input7-	A8
CL-HV VOLT.MON OUTPUT1 (0: 0V, 8000: 25kV)	Input2+	B1
CL-HV VOLT.MON OUTPUT1 (0: 0V, 8000: 25kV)	Input2-	B2
CL-HV CURR.MON OUTPUT1 (0: 0mA, 8000: 150mA)	Input4+	B3
CL-HV CURR.MON OUTPUT1 (0: 0mA, 8000: 150mA)	Input4-	B4
CL-HV Ep-k.MON (0: 0V, 8000: 25kV)	Input6+	B5
CL-HV Ep-k.MON (0: 0V, 8000: 25kV)	Input6-	B6
	Input8+	B7
	Input8-	B8

CL-HV_ANLG
XM3A-2521
XM2Z-0011

CL-HV_ANLG
Dsub25P

CL-HV_ANLG
Dsub25P

CL-HV
Laser Power
Supply Unit
IPN-20K200-M
CN1

CM-PLC1

NX-DA2203

CM-PLC1#12

2ch Analog Current Output 4-24mA 1/8000

Signal	I/O	PIN No.
CL-HV CURR.CONT (0: 0mA, 8000: 200mA)	I1+	A1
		A2
	IOV	A3
		A4
CL-HV CURR.CONT (0: 0mA, 8000: 200mA)	IOG	A5
		A6
	NC	A7
		A8
	I2+	B1
		B2
	IOV	B3
		B4
	IOG	B5
		B6
	NC	B7
		B8

CL-HV_ANLG
XM3A-2521
XM2Z-0011

CL-HV_ANLG
Dsub25P

CL-HV_ANLG
Dsub25P

CL-HV
Laser Power
Supply Unit
IPN-20K200-M
CN1

* : Crimp the wire ends with DIN 46228-4 ferrule.

* : Use "UL1007 BL AWG22" for the electric wires.

5
4
3
2
1

REV

DATE

MODIFICATION

APPD/BY

MOD/BY

RELEASED BY

TITLE

PLC1#11 / 12(AD4204 / DA2203)

SH No. 1 3

DWG No.

3AP-05854



PC

CM-PLC1

NX-AD4608		
CM-PLC1#13		
8ch Analog Voltage Input +/-10V 1/30000		
Signal	I/O	PIN No.
CL-OW-PT PZT POT (0: 0V 15000:10V)	Input1+	A1
CL-OW-PT PZT POT (0: 0V 15000:10V)	Input1-	A2
C0-SC-PS DC offset V.Monitor (0: 0kV,15000:10000V)	Input3+	A3
C0-SC-PS DC offset V.Monitor (0: 0kV,15000:10000V)	Input3-	A4
C0-SB-OM TBD (0:0V 15000: 10V)	Input5+	A5
C0-SB-OM TBD (0:0V 15000: 10V)	Input5-	A6
F*-FL-MFC FLOW PV (0: 0, 7500: 100%F.S=10scm)	Input7+	A7
F*-FL-MFC FLOW PV (0: 0, 7500: 100%F.S=10scm)	Input7-	A8
CL-OW-PD Output voltage monitor(0: 0V 15000: 150V)	Input2+	B1
CL-OW-PD Output voltage monitor(0: 0V 15000: 150V)	Input2-	B2
C0-SC-LA Intensity (0:0V 15000: 10V)	Input4+	B3
C0-SC-LA Intensity (0:0V 15000: 10V)	Input4-	B4
C1-PM Power (0:0 W 15000: 300W)	Input6+	B5
C1-PM Power (0:0 W 15000: 300W)	Input6-	B6
F*-SC-MFC FLOW PV (0: 0, 7500: 100%F.S= 10scm)	Input8+	B7
F*-SC-MFC FLOW PV (0: 0, 7500: 100%F.S= 10scm)	Input8-	B8

(113A1)

(113A2)

(113A3)

(113A4)

(113A5)

(113A6)

(113A7)

(113A8)

(113B1)

(113B2)

(113B3)

(113B4)

(113B5)

(113B6)

(113B7)

(113B8)

(113B9)

(113B10)

(113B11)

(113B12)

(113B13)

(113B14)

(113B15)

(113B16)

(113B17)

(113B18)

(113B19)

(113B20)

(113B21)

(113B22)

(113B23)

(113B24)

(113B25)

(113B26)

(113B27)

(113B28)

(113B29)

(113B30)

(113B31)

(113B32)

(113B33)

(113B34)

(113B35)

(113B36)

(113B37)

(113B38)

(113B39)

(113B40)

(113B41)

(113B42)

(113B43)

(113B44)

(113B45)

(113B46)

(113B47)

(113B48)

(113B49)

(113B50)

(113B51)

(113B52)

(113B53)

(113B54)

(113B55)

(113B56)

(113B57)

(113B58)

(113B59)

(113B60)

(113B61)

(113B62)

(113B63)

(113B64)

(113B65)

(113B66)

(113B67)

(113B68)

(113B69)

(113B70)

(113B71)

(113B72)

(113B73)

(113B74)

(113B75)

(113B76)

(113B77)

(113B78)

(113B79)

(113B80)

(113B81)

(113B82)

(113B83)

(113B84)

(113B85)

(113B86)

(113B87)

(113B88)

(113B89)

(113B90)

(113B91)

(113B92)

(113B93)

(113B94)

(113B95)

(113B96)

(113B97)

(113B98)

(113B99)

(113B100)

(113B101)

(113B102)

(113B103)

(113B104)

(113B105)

(113B106)

(113B107)

(113B108)

(113B109)

(113B110)

(113B111)

(113B112)

(113B113)

(113B114)

(113B115)

(113B116)

(113B117)

(113B118)

(113B119)

(113B120)

(113B121)

(113B122)

(113B123)

(113B124)

(113B125)

(113B126)

(113B127)

(113B128)

(113B129)

(113B130)

(113B131)

(113B132)

(113B133)

(113B134)

(113B135)

(113B136)

(113B137)

(113B138)

(113B139)

(113B140)

(113B141)

(113B142)

(113B143)

(113B144)

(113B145)

(113B146)

(113B147)

(113B148)

(113B149)

(113B150)

(113B151)

(113B152)

(113B153)

(113B154)

(113B155)

(113B156)

(113B157)

(113B158)

(113B159)

(113B160)

(113B161)

(113B162)

(113B163)

(113B164)

(113B165)

(113B166)

(113B167)

(113B168)

(113B169)

(113B170)

(113B171)

(113B172)

(113B173)

(113B174)

(113B175)

(113B176)

(113B177)

(113B178)

(113B179)

(113B180)

(113B181)

(113B182)

(113B183)

(113B184)

(113B185)

(113B186)

(113B187)

(113B188)

(113B189)

(113B190)

(113B191)

(113B192)

(113B193)

(113B194)

(113B195)

(113B196)

(113B197)

(113B198)

(113B199)

(113B200)

(113B201)

(113B202)

(113B203)

(113B204)

(113B205)

(113B206)

(113B207)

(113B208)

(113B209)

(113B210)

(113B211)

(113B212)

(113B213)

(113B214)

(113B215)

(113B216)

(113B217)

(113B218)

(113B219)

(113B220)

(113B221)

(113B222)

(113B223)

(113B224)

(113B225)

(113B226)

(113B227)

(113B228)

(113B229)

(113B230)

(113B231)

(113B232)

(113B233)

(113B234)

(113B235)

(113B236)

(113B237)

(113B238)

(113B239)

(113B240)

(113B241)

(113B242)

(113B243)

(113B244)

(113B245)

(113B246)

(113B247)

(113B248)

(113B249)

(113B250)

(113B251)

(113B252)

(113B253)

(113B254)

(113B255)

(113B256)

(113B257)

(113B258)

(113B259)

(113B260)

(113B261)

(113B262)

(113B263)

(113B264)

(113B265)

(113B266)

(113B267)

(113B268)

(113B269)

(113B270)

(113B271)

(113B272)

(113B273)

(113B274)

(113B275)

(113B276)

(113B277)

(113B278)

(113B279)

(113B280)

(113B281)

(113B282)

(113B283)

(113B284)

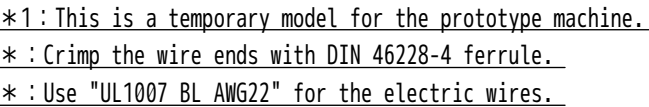
(113B285)

(113B286)

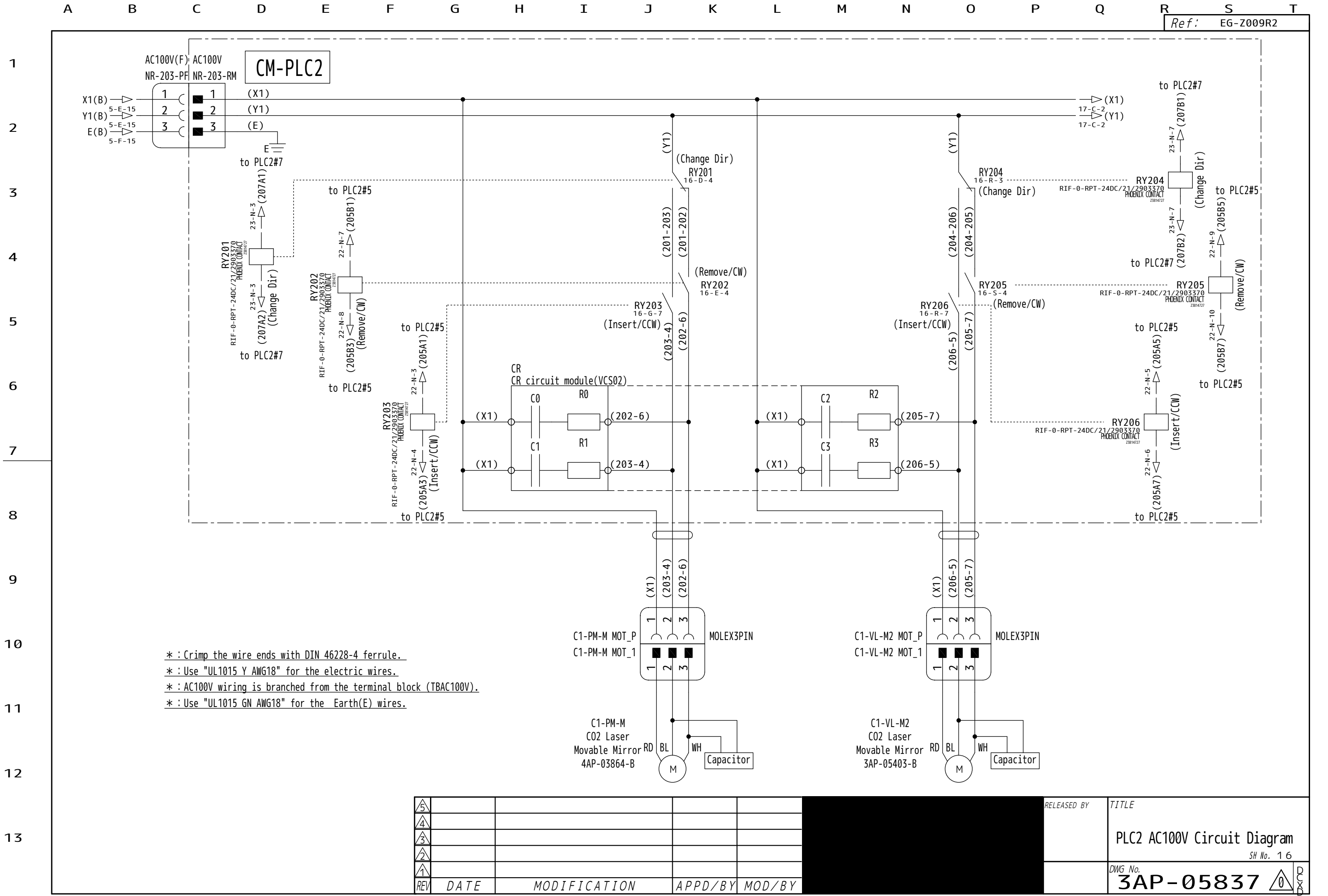
(113B287)

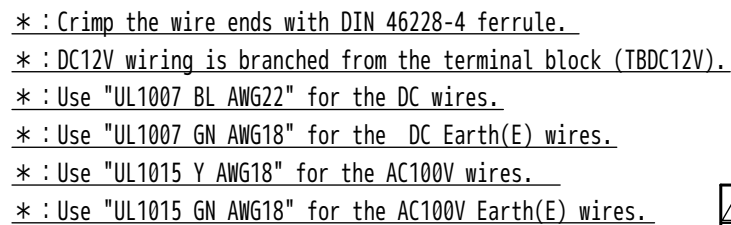
(113B288)

(113B289)

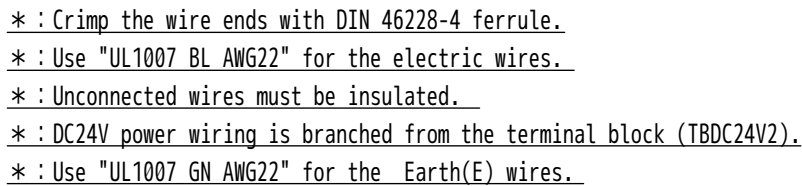


5						RELEASED BY	TITLE PLC1#14 / 15(DA3605 / TS3204) SH No. 1 5	
4								
3								
2								
1								
REV	DATE	MODIFICATION	APPD / BY	MOD / BY			DWG No. 3AP-05856 	



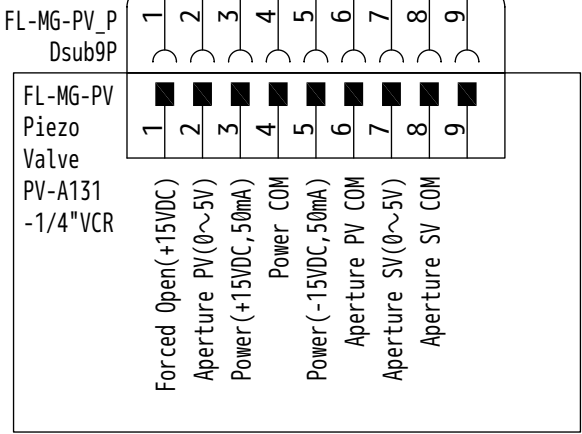
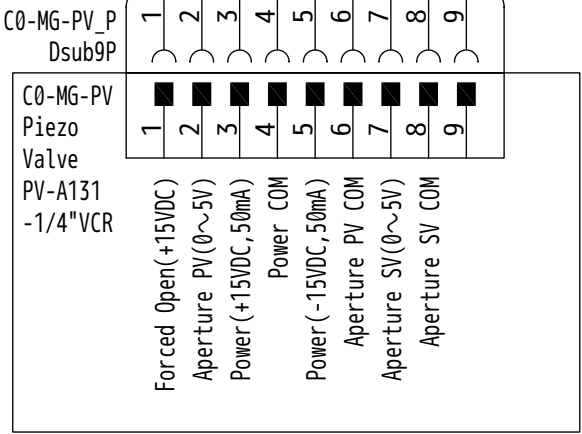
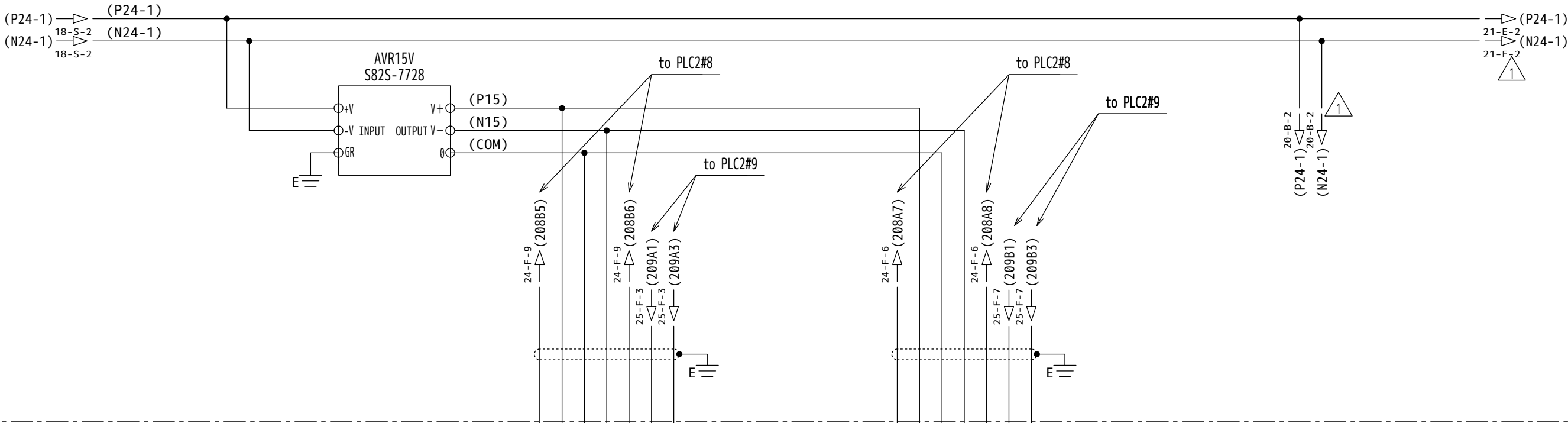


5						RELEASED BY	TITLE	PLC2 DC12V Circuit Diagram	SH No. 17	
4										
3										
2										
1										
REV	DATE	MODIFICATION	APPD/BY	MOD/BY			DWG No.	3AP-05838		Doc



5						RELEASED BY	TITLE
4							
3							
2							
1							
REV	DATE	MODIFICATION	APPD/BY	MOD/BY			DWG No. 3AP-05839 

CM-PLC2



- * : Crimp the wire ends with DIN 46228-4 ferrule.
- * : Use "UL1007 BL AWG22" for the electric wires.
- * : DC24V power wiring is branched from the terminal block (TBDC24V2).
- * : DC15V power wiring is branched from the terminal block (TBDC15V).
- * : Use "UL1007 Y AWG18" for the Earth(E) wires.

5				
4				
3				
2				
1	26/Jan/2023	Circuit change.	S.Nishi	Maezeki
REV	DATE	MODIFICATION	APPD/BY	MOD/BY

RELEASED BY

TITLE

PLC2 DC15V Circuit Diagram

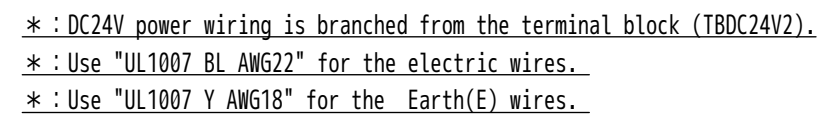
SH No. 19

DWG No.

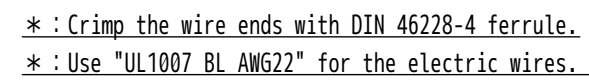
3AP-05840



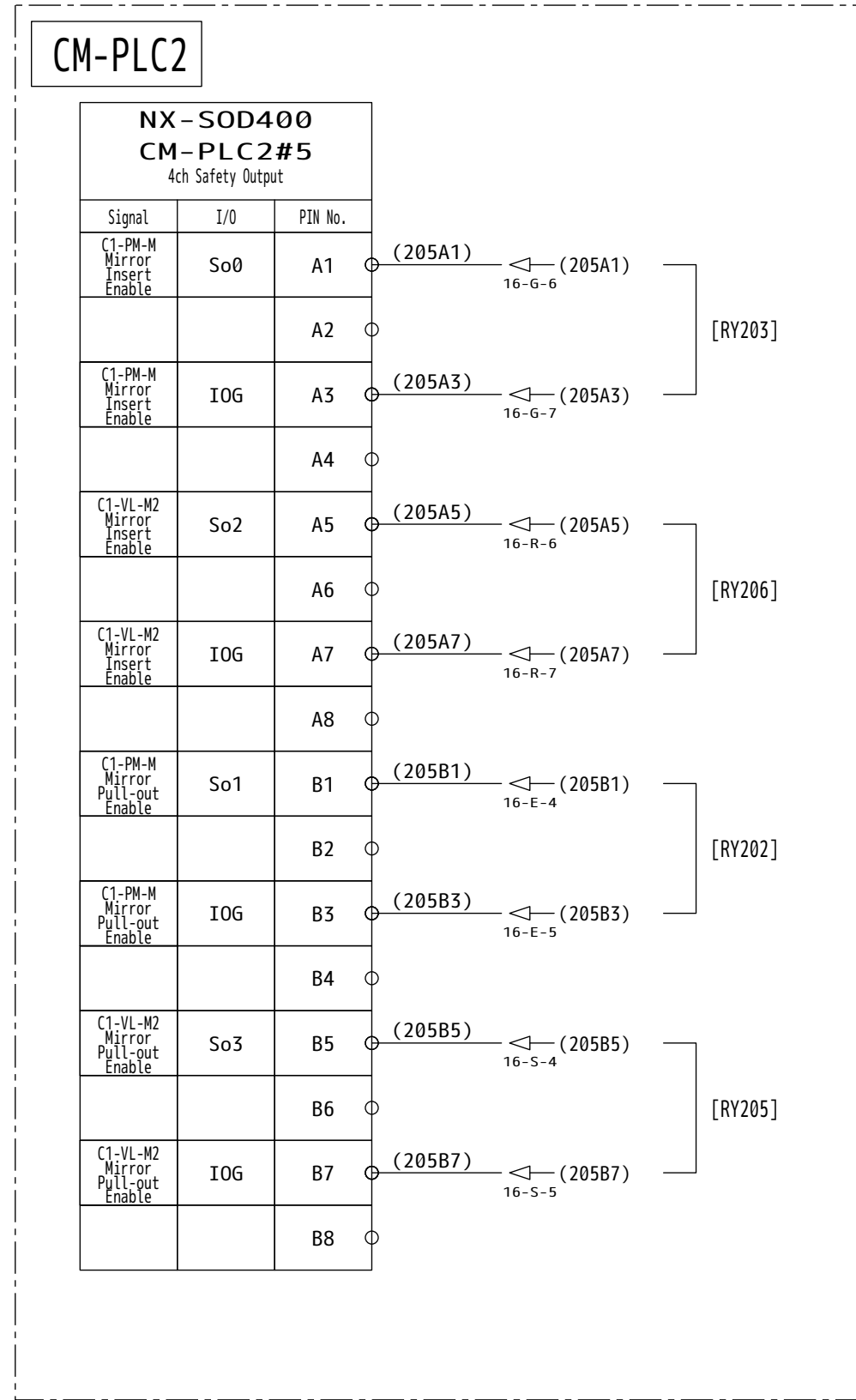
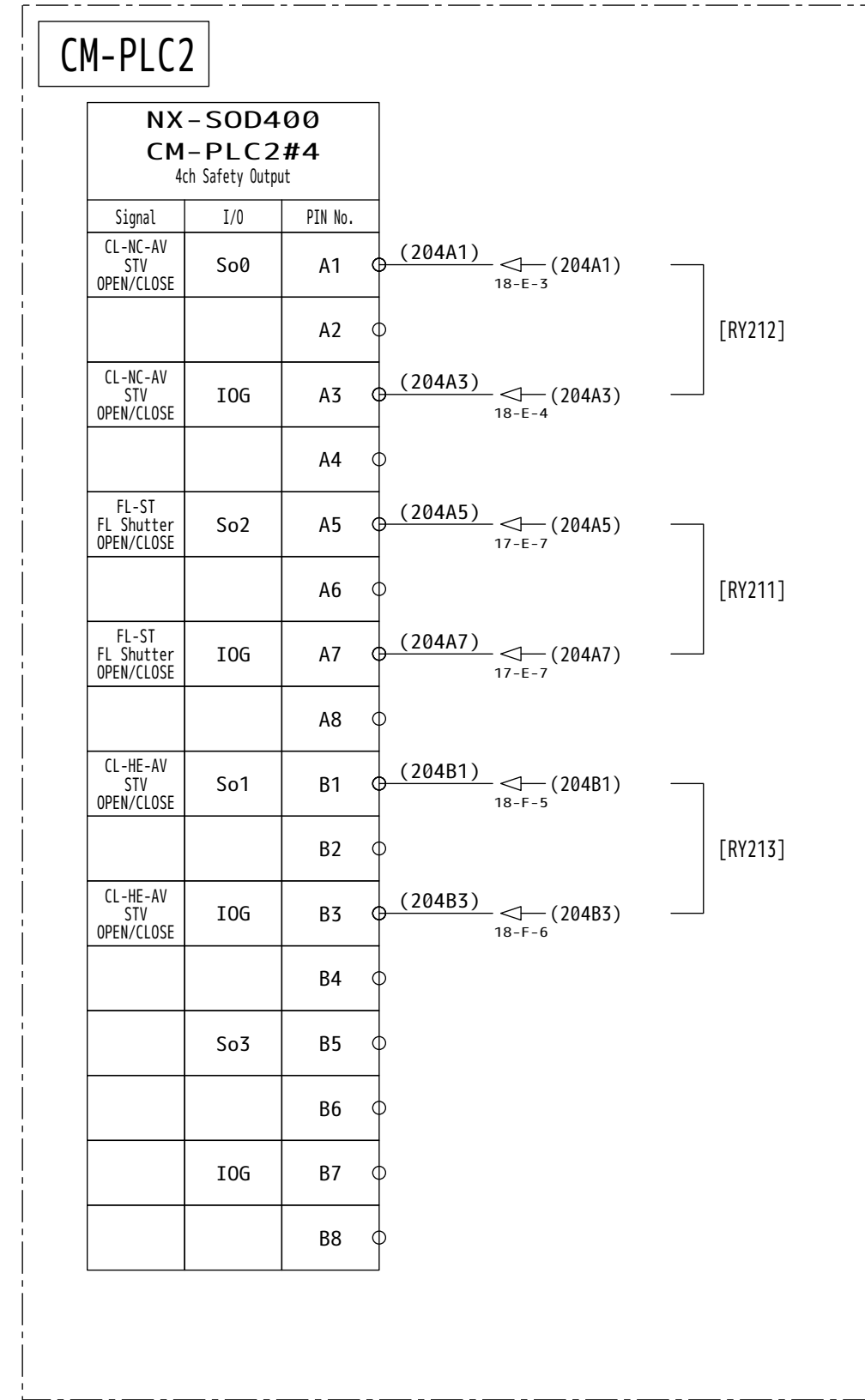
REV



5						RELEASED BY	TITLE	
4							PLC2#0(DC24V)	
3						SH No. 20		
2						DWG No.		
1						3AP-05867 		
REV	DATE	MODIFICATION	APPD/BY	MOD/BY				



5					[REDACTED]	RELEASED BY	TITLE
4							PLC2#2 / 3 (SID800 / SID800)
3							SH No. 2 1
2							
1	26/Jan/2023	Added pressure gauge.				DWG No.	3AP-05841 1
REV	DATE	MODIFICATION	APPD/BY	MOD/BY			1



- * : Crimp the wire ends with DIN 46228-4 ferrule.
- * : Use "UL1007 BL AWG22" for the electric wires.

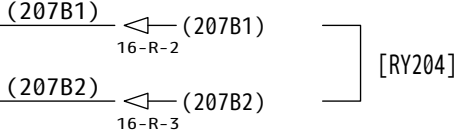
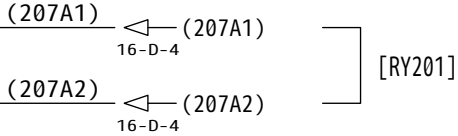
5						RELEASED BY	TITLE			
4							PLC2#4 / 5(S0D400 / S0D400)			
3						SH No. 2 2				
2										
1										
REV	DATE	MODIFICATION	APPD/BY	MOD/BY			DWG No.	3AP-05842		DWG No.

CM-PLC2

NX-ID4442 CM-PLC2#6 8ch Digital Input (PNP)		
Signal	I/O	PIN No.
	IN0	A1
	IOV0	A2
	IN2	A3
	IOV2	A4
	IN4	A5
	IOV4	A6
	IN6	A7
	IOV6	A8
	IN1	B1
	IOV1	B2
	IN3	B3
	IOV3	B4
	IN5	B5
	IOV5	B6
	IN7	B7
	IOV7	B8

CM-PLC2

NX-OD4256 CM-PLC2#7 8ch Digital Output (PNP)		
Signal	I/O	PIN No.
C1-PM-M Change Direction	OUT0	A1
C1-PM-M Change Direction	IOG0	A2
	OUT2	A3
	IOG2	A4
	OUT4	A5
	IOG4	A6
	OUT6	A7
	IOG6	A8
C1-VL-M2 Change Direction	OUT1	B1
C1-VL-M2 Change Direction	IOG1	B2
	OUT3	B3
	IOG3	B4
	OUT5	B5
	IOG5	B6
	OUT7	B7
	IOG7	B8

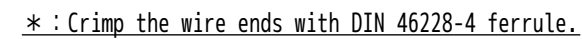


* : Crimp the wire ends with DIN 46228-4 ferrule.

* : Use "UL1007 BL AWG22" for the electric wires.

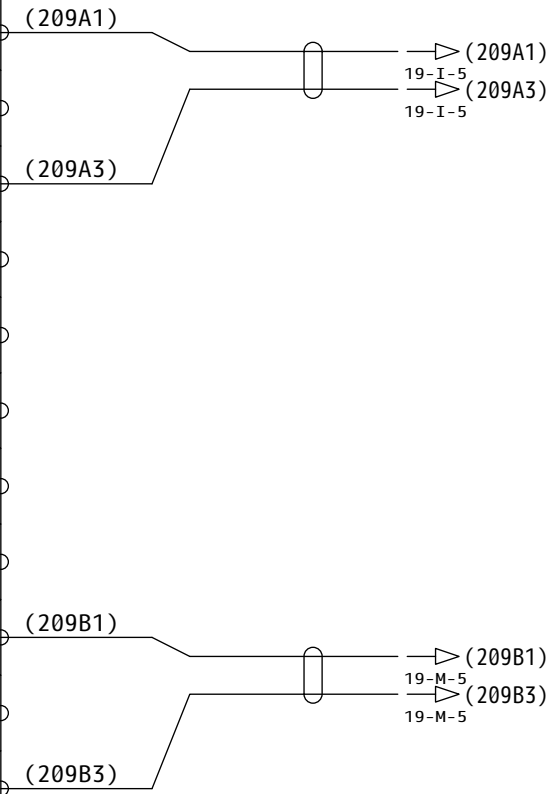
5						RELEASED BY	TITLE
4							PLC2#6 / 7 (ID4442 / OD4256)
3							SH No. 2 3
2							
1							
REV	DATE	MODIFICATION	APPD / BY	MOD / BY			DWG No. 3AP-05843
							0
							DCX

NX-AD4608 CM-PLC2#8 8ch Analog Voltage Input +/-10V 1/30000		
Signal	I/O	PIN No.
CL-GT1-PD Intensity (0: 0mV 15000: 10000mV)	Input1+	A1
CL-GT1-PD Intensity (0: 0mV 15000: 10000mV)	Input1-	A2
CO-PM Power (0: 0 W 15000: 300W)	Input3+	A3
CO-PM Power (0: 0 W 15000: 300W)	Input3-	A4
FL-OM-CB Monitor Voltage (0: 0V 15000: 10V)	Input5+	A5
FL-OM-CB Monitor Voltage (0: 0V 15000: 10V)	Input5-	A6
FL-MG-PV Aperture PV (0: 0% 7500: 100%)	Input7+	A7
FL-MG-PV Aperture PV (0: 0% 7500: 100%)	Input7-	A8
CL-GT2-PD Intensity (0: 0mV 15000: 10000mV)	Input2+	B1
CL-GT2-PD Intensity (0: 0mV 15000: 10000mV)	Input2-	B2
FL-PM Power (0: 0 W 15000: 300W)	Input4+	B3
FL-PM Power (0: 0 W 15000: 300W)	Input4-	B4
CO-MG-PV Aperture PV (0: 0% 7500: 100%)	Input6+	B5
CO-MG-PV Aperture PV (0: 0% 7500: 100%)	Input6-	B6
	Input8+	B7
	Input8-	B8

SH No. 24

CM-PLC2

NX-DA3605		
CM-PLC2#9		
4ch Analog Voltage Output +/-10V 1/30000		
Signal	I/O	PIN No.
C0-MG-PV Aperture SV (0: 0% 7500: 100%)	V1+	A1
	I0V	A2
C0-MG-PV Aperture SV (0: 0% 7500: 100%)	I0G	A3
	V3+	A4
	I0V	A5
	I0G	A6
		A7
		A8
FL-MG-PV Aperture SV (0: 0% 7500: 100%)	V2+	B1
	I0V	B2
FL-MG-PV Aperture SV (0: 0% 7500: 100%)	I0G	B3
	V4+	B4
	I0V	B5
	I0G	B6
		B7
		B8



C0-MG-PV
Piezo Valve
SV 0~5V
PV-A131-1/4"VCR

FL-MG-PV
Piezo Valve
SV 0~5V
PV-A131-1/4"VCR

* :Crimp the wire ends with DIN 46228-4 ferrule.
* : Use "UL1007 BL AWG22" for the electric wires.

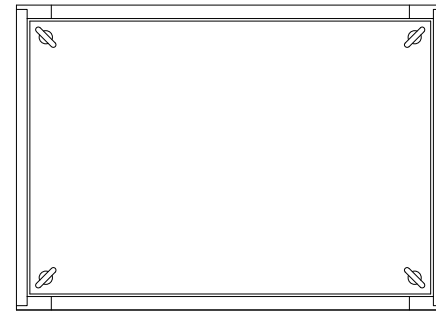
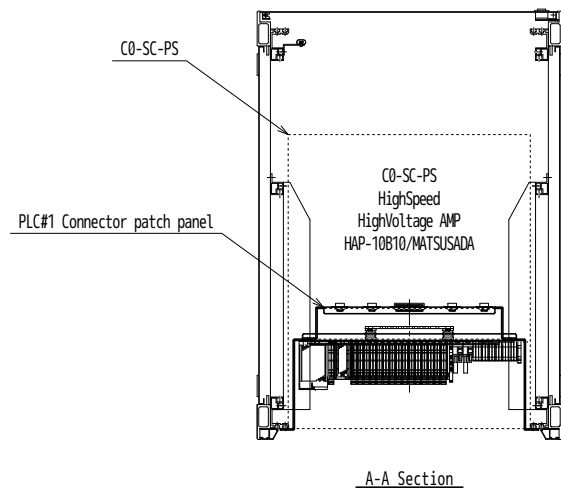
5						RELEASED BY	TITLE
4							
3							
2							
1							
REV	DATE	MODIFICATION	APPD/BY	MOD/BY			

DWG No.3AP-05845

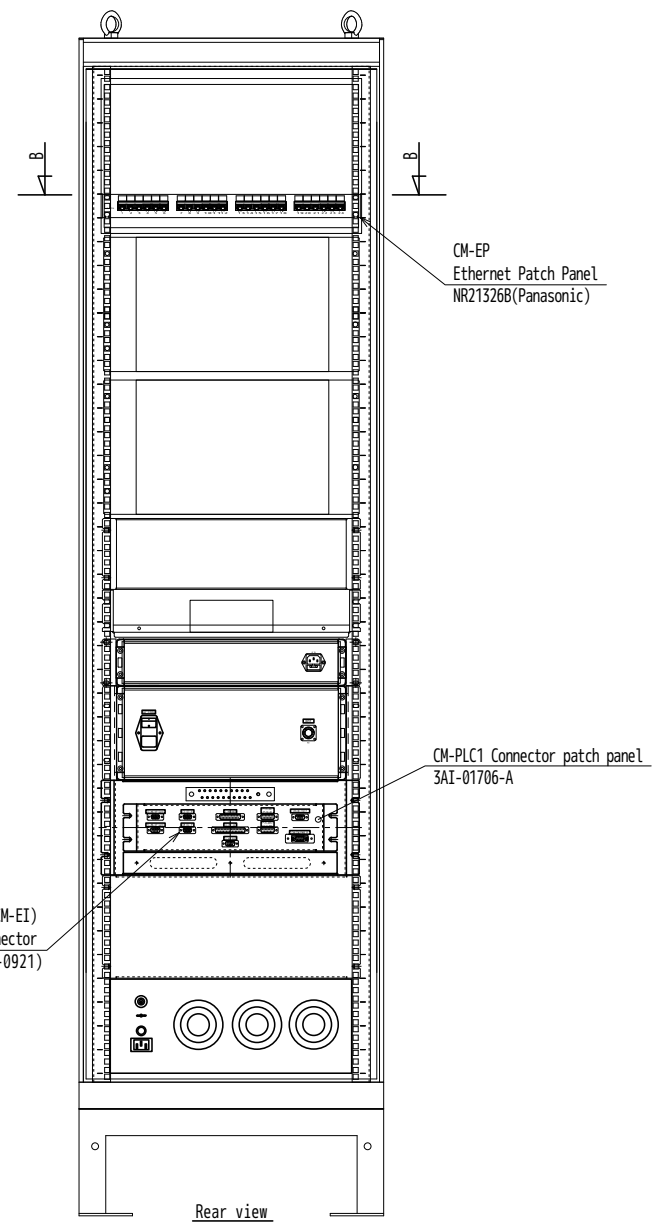
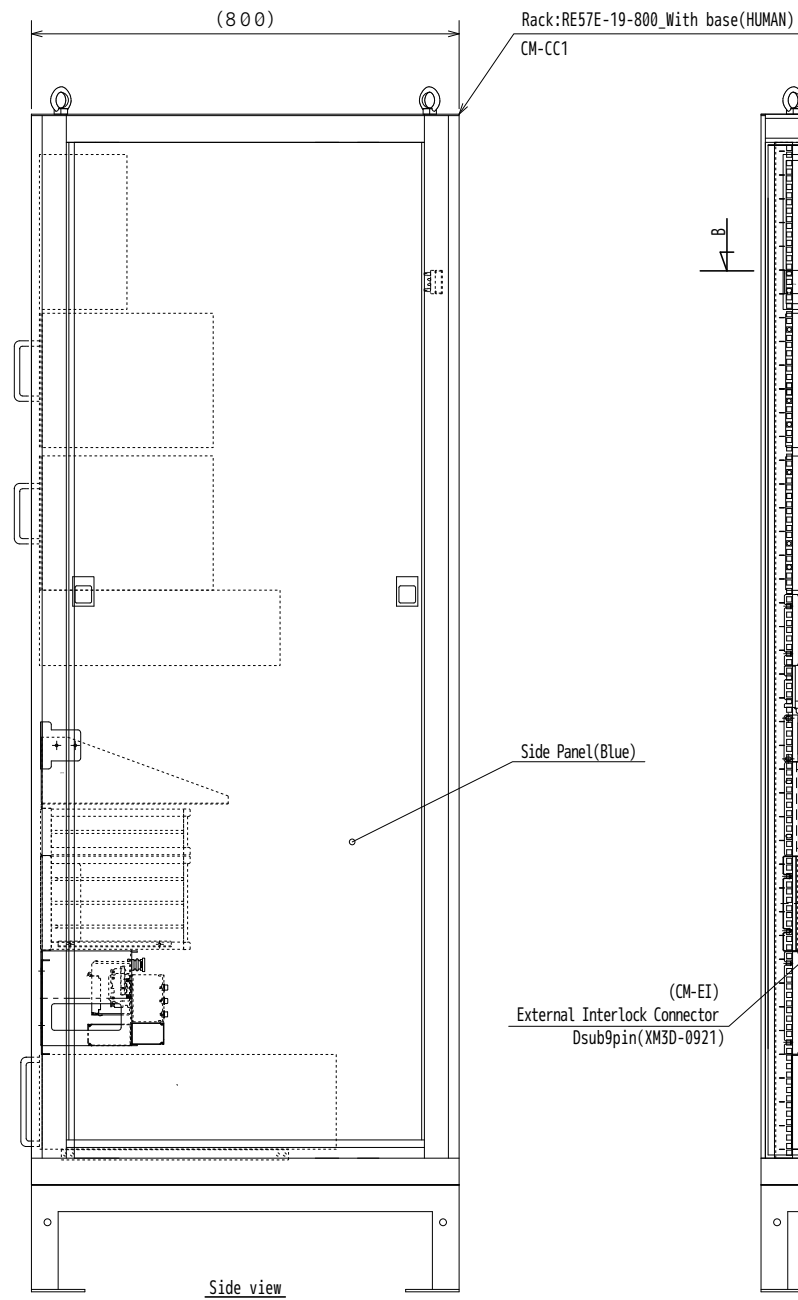
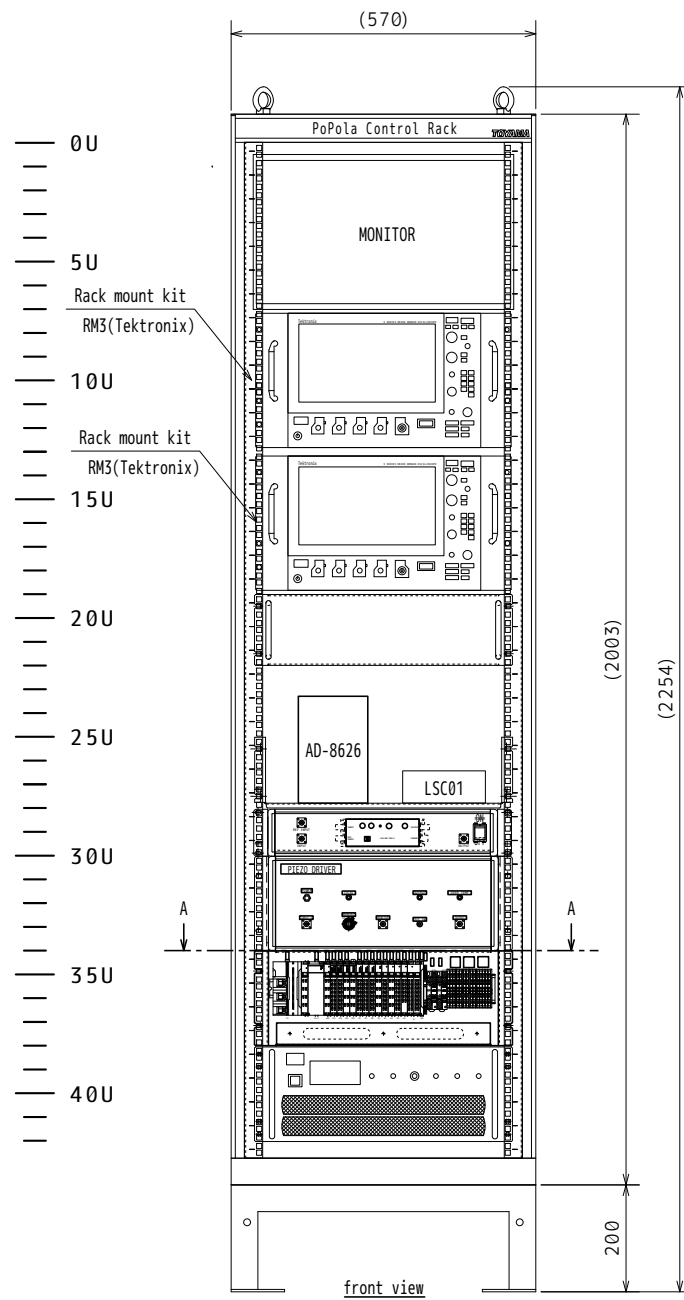
SH No. 25

PCB

APPENDIX VIII : Control Cabinet Diagram

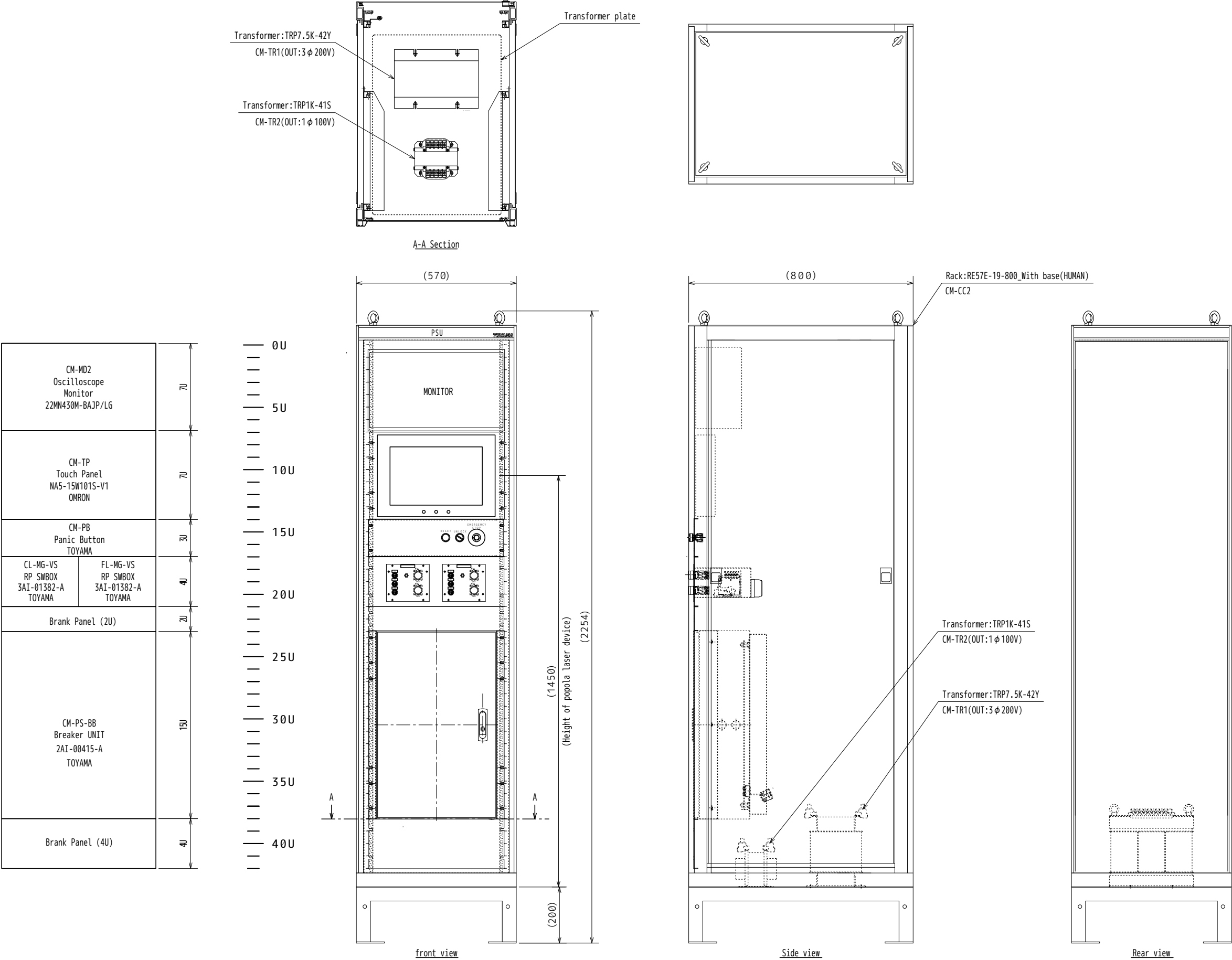


CM-MD1 Oscilloscope Monitor 22MN430M-BAJP/LG	
FL-OS FIR Oscilloscope MDO34 3-BW-100 Tektronix	
CL-OS CO2 Oscilloscope MDO34 3-BW-100 Tektronix	
CO-SB-OM Output Monitor+ CO2 Differential amplifier(X10) 6IGA	
CO-SC-WG Oscillator (SineWaveGenerator) AD8626/A&D	C1-ST LaserBaem ShutterController LSC01/Thorlabs
CO-SC-LA Lock-in Amp BOX:3AI-01708-A (LIA-WV-150-S/Femto)	
CL-OW-PD CL-OW-PT Piezo driver BOX:3AI-01709-A M-2501-1/Messtec	
CM-PLC1 3AI-01704-A	
CO-SC-PS HighSpeed HighVoltage AMP HAP-10B10/MATSUSADA	



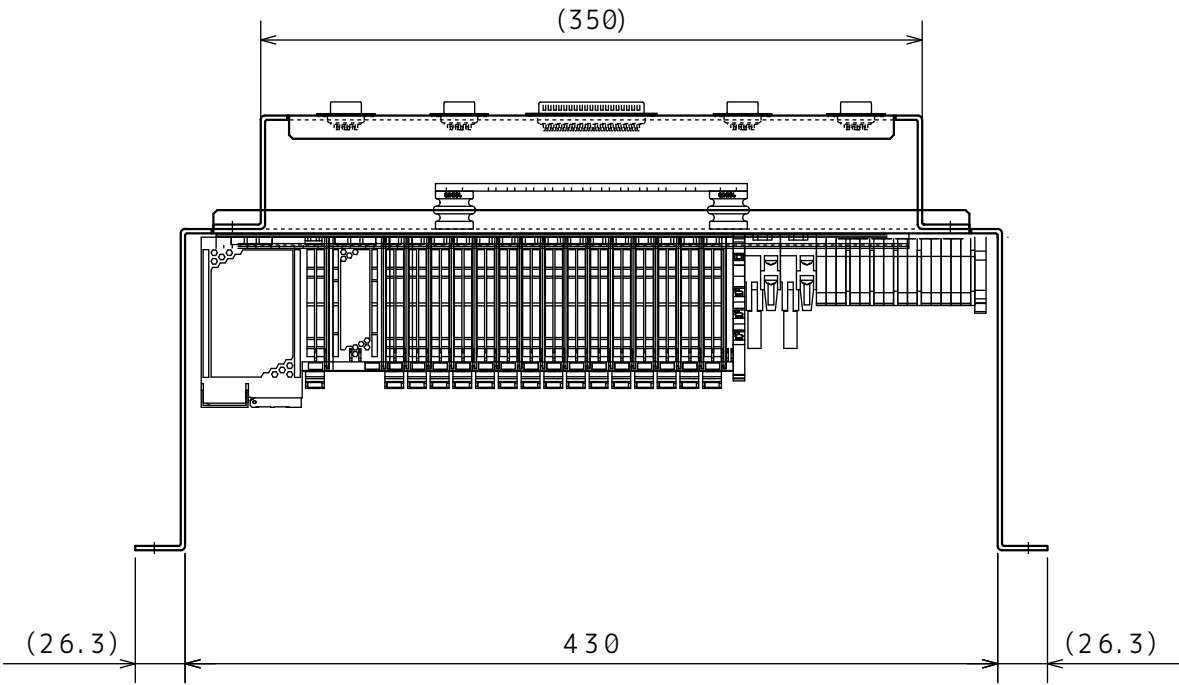
△				
△				
△				
△				
REV	DATE	MODIFICATION	APPD/BY	MOD/BY

RELEASED BY	TITLE
	Control cabinet(CM-CC1)
Scale	DWG No.
1 : 10	2AI-00414
	SH No. 26



△				
△				
△				
△				
△				
REV	DATE	MODIFICATION	APPD/BY	MOD/BY

RELEASED BY	TITLE
	Control cabinet PSU(CM-CC2)
Scale 1 : 1 0	DWG No. 2AI-00516



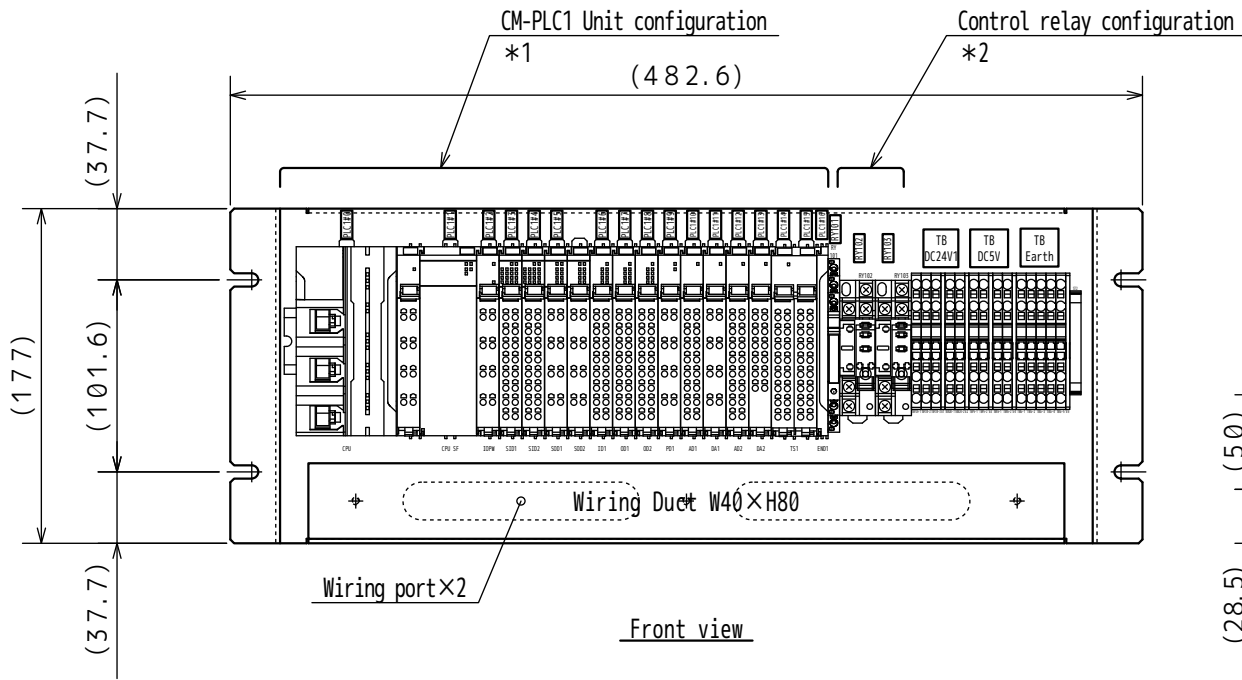
Top view

PLC Unit No.	Parts number
CM-PLC1#0	NX102-9000
CM-PLC1#1	NX-SL3300
CM-PLC1#2	NX-PF0630
CM-PLC1#3	NX-SID800
CM-PLC1#4	NX-SID800
CM-PLC1#5	NX-SOD400
CM-PLC1#6	NX-SOD400
CM-PLC1#7	NX-ID4442
CM-PLC1#8	NX-OD4256
CM-PLC1#9	NX-OD4256
CM-PLC1#10	NX-PD1000
CM-PLC1#11	NX-AD4204
CM-PLC1#12	NX-DA2203
CM-PLC1#13	NX-AD4608
CM-PLC1#14	NX-DA3605
CM-PLC1#15	NX-TS3204
CM-PLC1#16	NX-END02

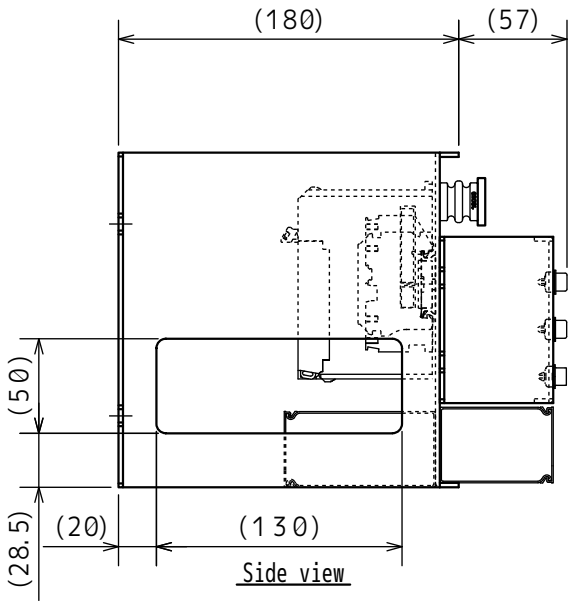
*1: CM-PLC1 Unit configuration

Relay No.	Parts number
RY101	RIF-0-RPT-24DC
RY102	G3TA-IDZR02S DC5-24
RY103	G3TA-IDZR02S DC5-24

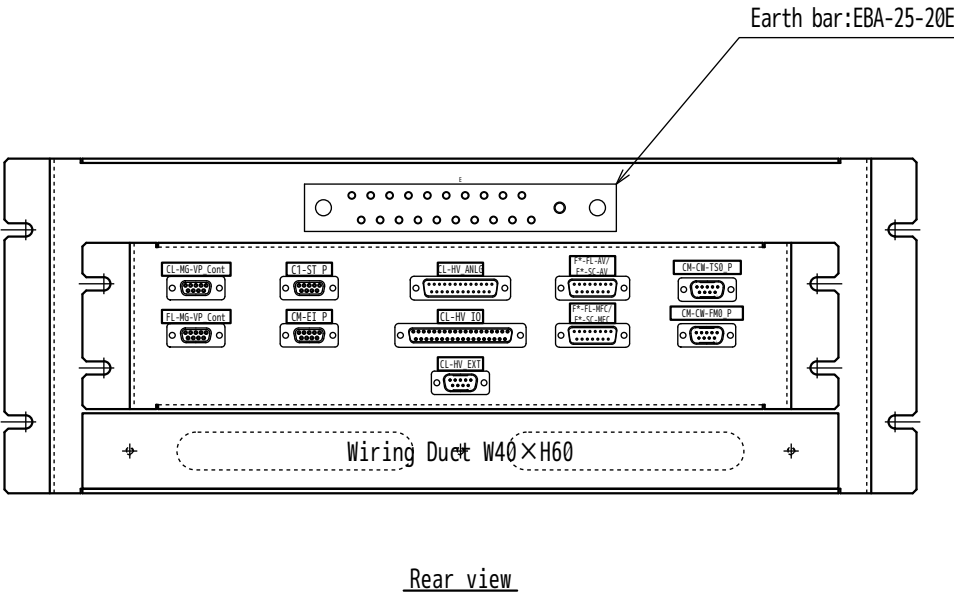
*2: Control relay configuration



Front view



Side view

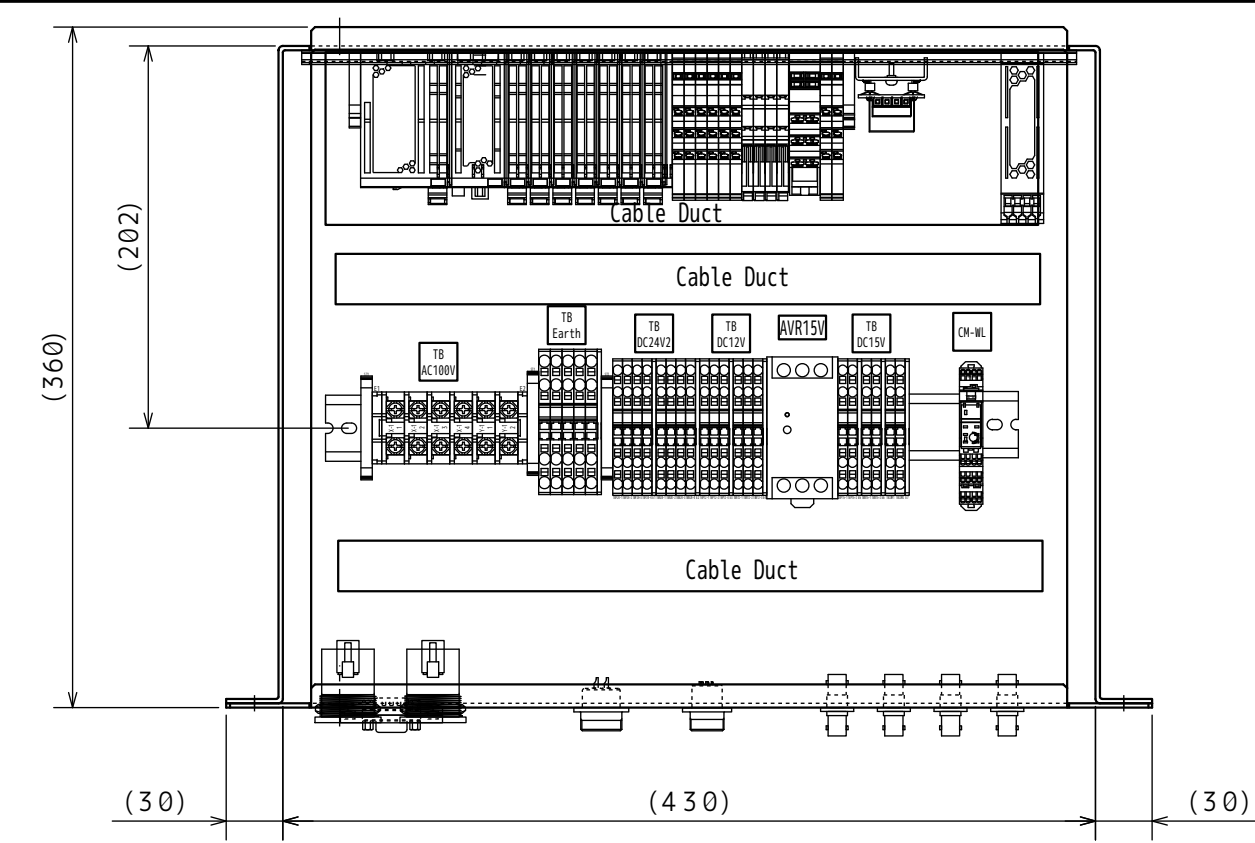


Rear view

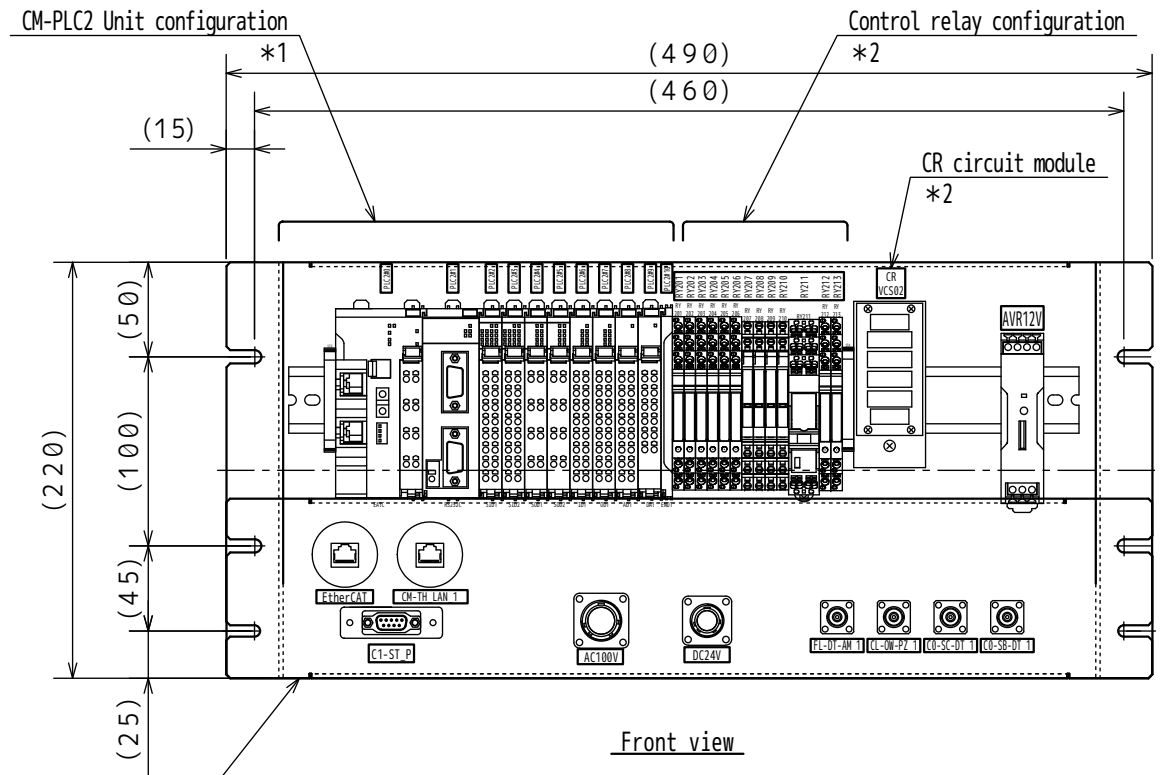
*:This unit is mounted the PoPola control rack. (2AI-00414)

5					
4					
3					
2					
1					
REV	DATE	MODIFICATION	APPD/BY	MOD/BY	

RELEASED BY	TITLE
	PLC UNIT(CM-PLC1)
Scale	DWG No.
1:4	3AI-01704
	SH No. 28



Top view



Front view

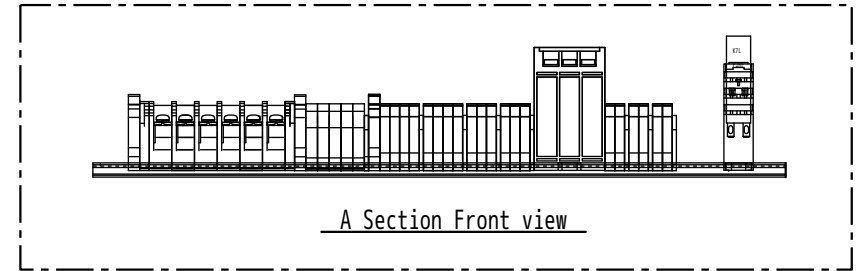
Connector Panel
3AI-01707-A

PLC Unit No.	Parts number
CM-PLC2#0	NX-ECC203
CM-PLC2#1	NX-CIF210
CM-PLC2#2	NX-SID800
CM-PLC2#3	NX-SID800
CM-PLC2#4	NX-SOD400
CM-PLC2#5	NX-SOD400
CM-PLC2#6	NX-ID4442
CM-PLC2#7	NX-OD4256
CM-PLC2#8	NX-AD4608
CM-PLC2#9	NX-DA3605
CM-PLC2#10	NX-END02

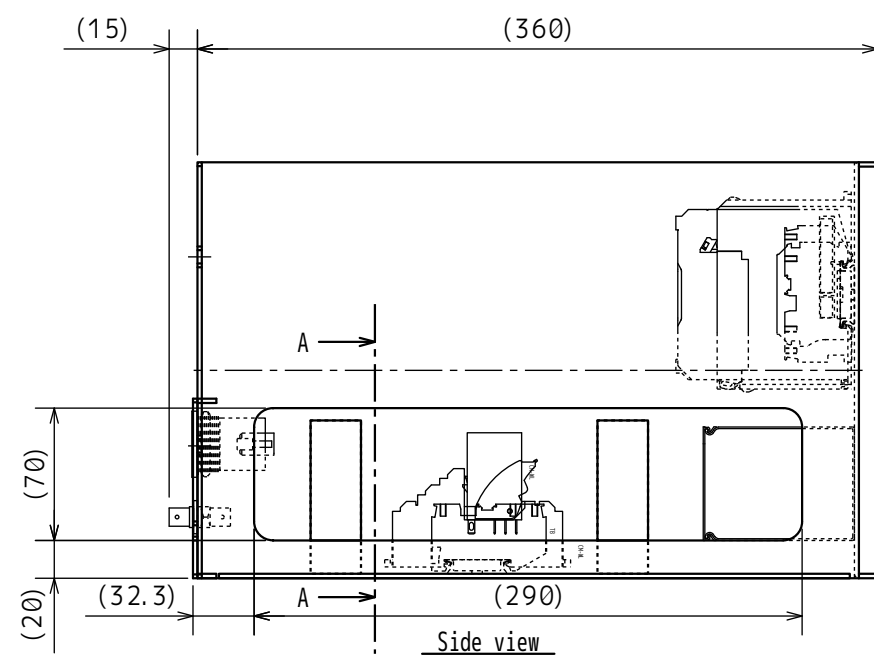
*1: CM-PLC2 Unit configuration

Relay No.	Parts number
RY201	RIF-0-RPT-24DC
RY202	RIF-0-RPT-24DC
RY203	RIF-0-RPT-24DC
RY204	RIF-0-RPT-24DC
RY205	RIF-0-RPT-24DC
RY206	RIF-0-RPT-24DC
RY207	G2RV-SR500 DC12V
RY208	G2RV-SR500 DC12V
RY209	G2RV-SR500 DC12V
RY210	G2RV-SR500 DC12V
RY211	RIF-1-RPT-LDP-24DC
RY212	RIF-0-RPT-24DC
RY213	RIF-0-RPT-24DC

*2: Control relay configuration



A Section Front view



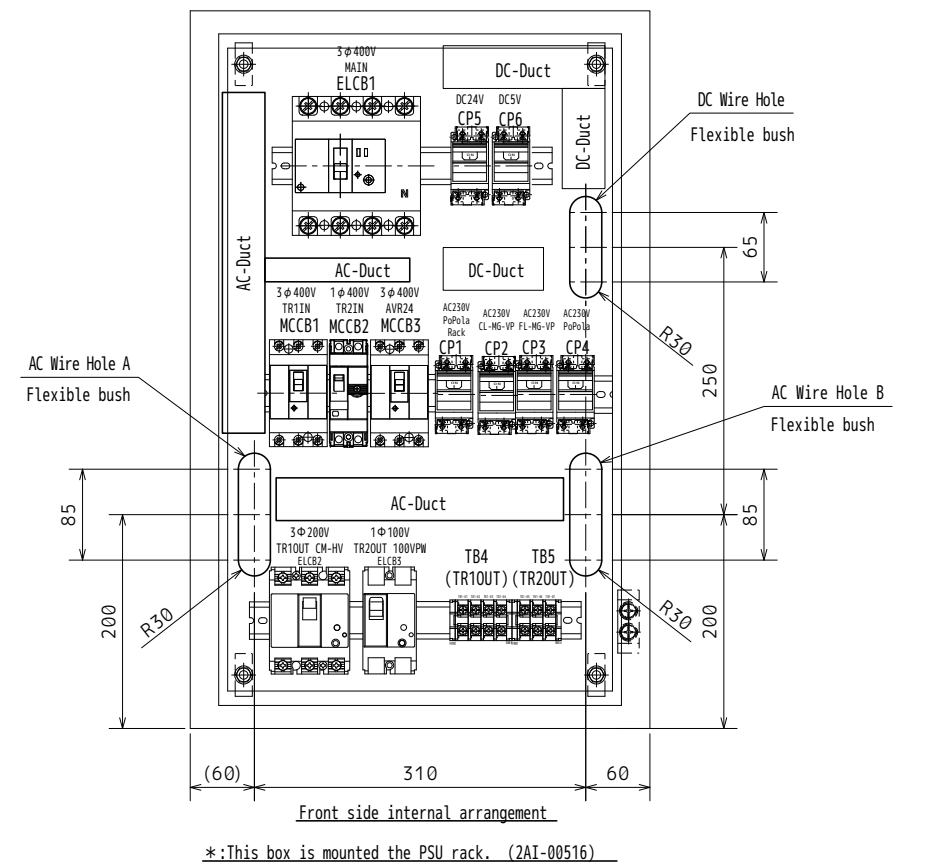
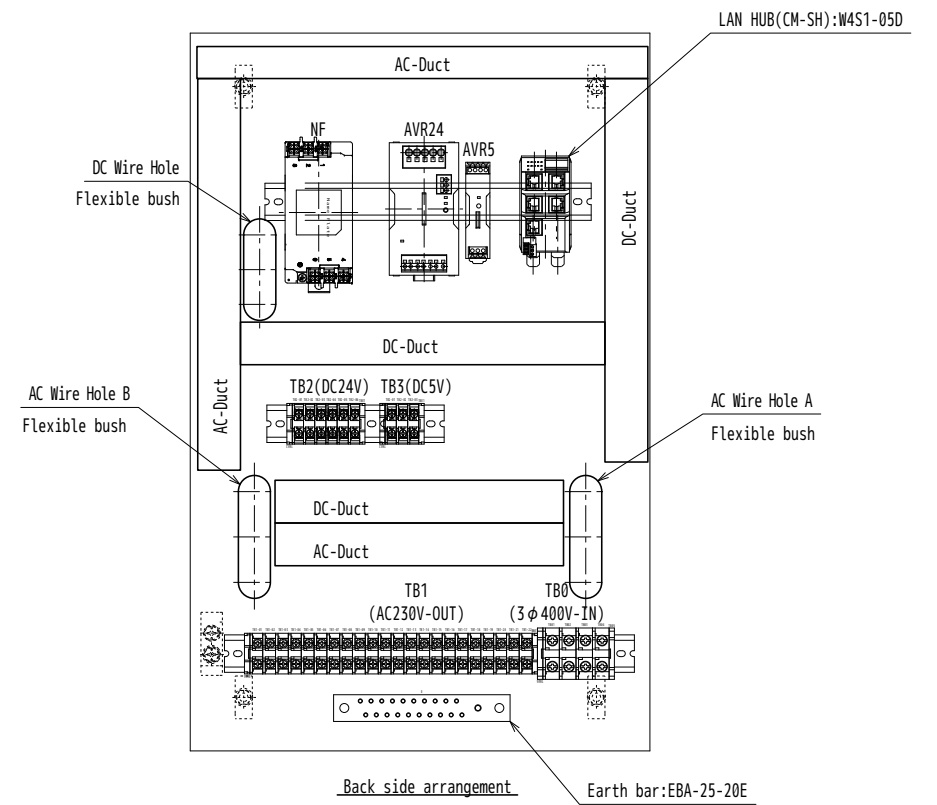
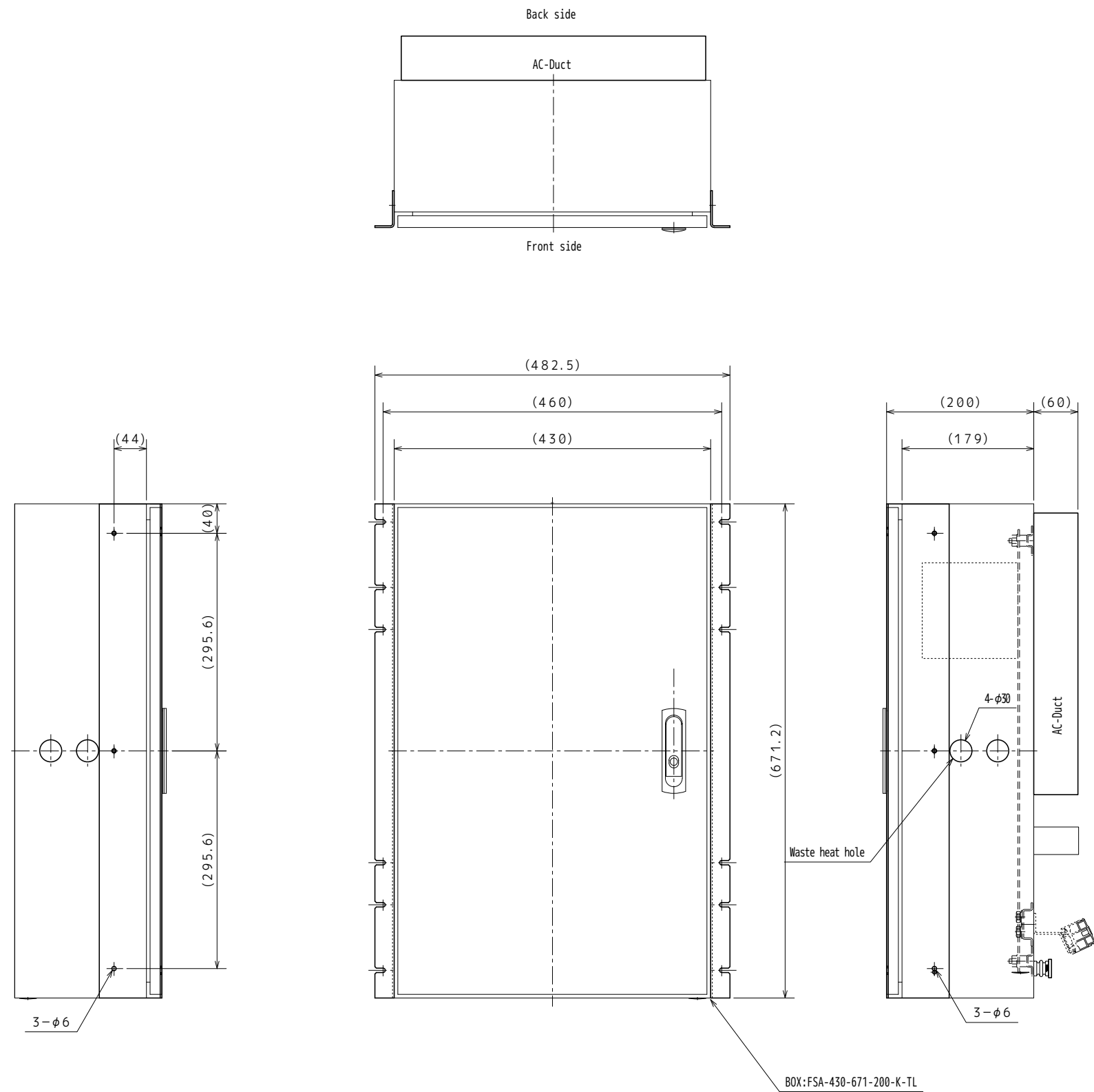
Side view

*:This unit is mounted under the PoPola laser table. (Mechanical drawing)

REV	DATE	MODIFICATION	APPD/BY	MOD/BY
5				
4				
3				
2				
1				

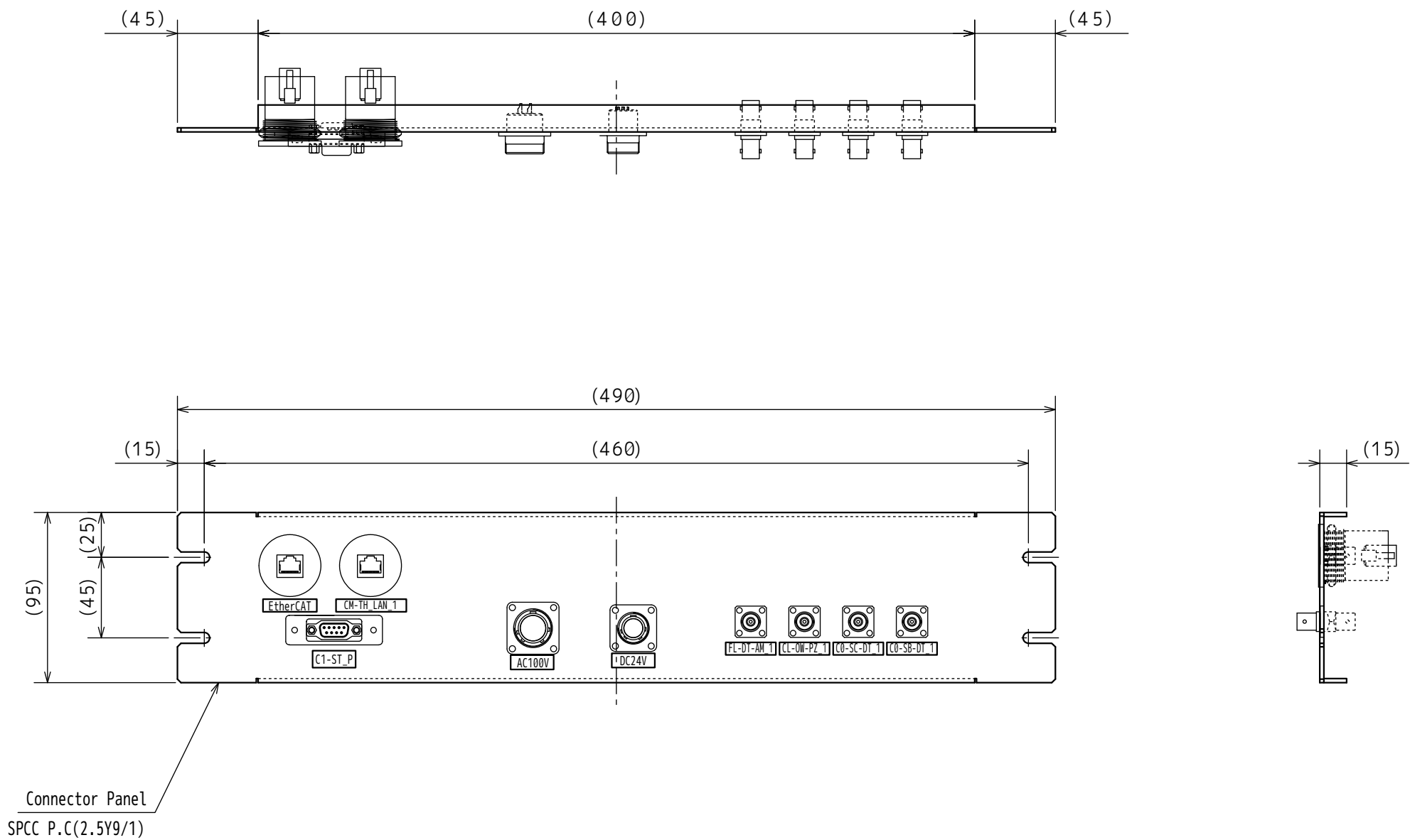
RELEASED BY	TITLE
	PLC UNIT(CM-PLC2)
Scale	DWG No.
1:4	3AI-01713

SH No. 29



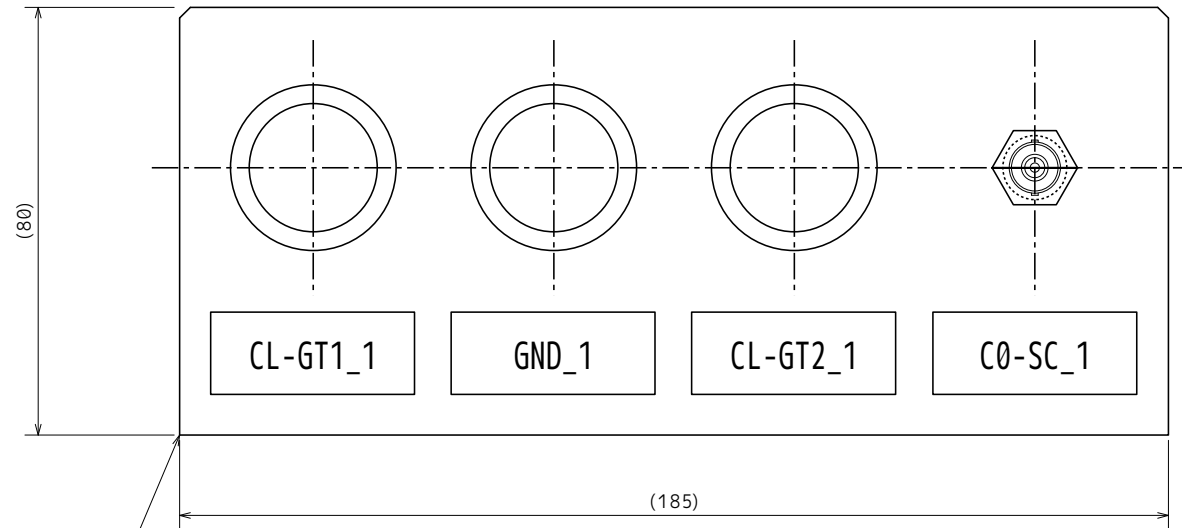
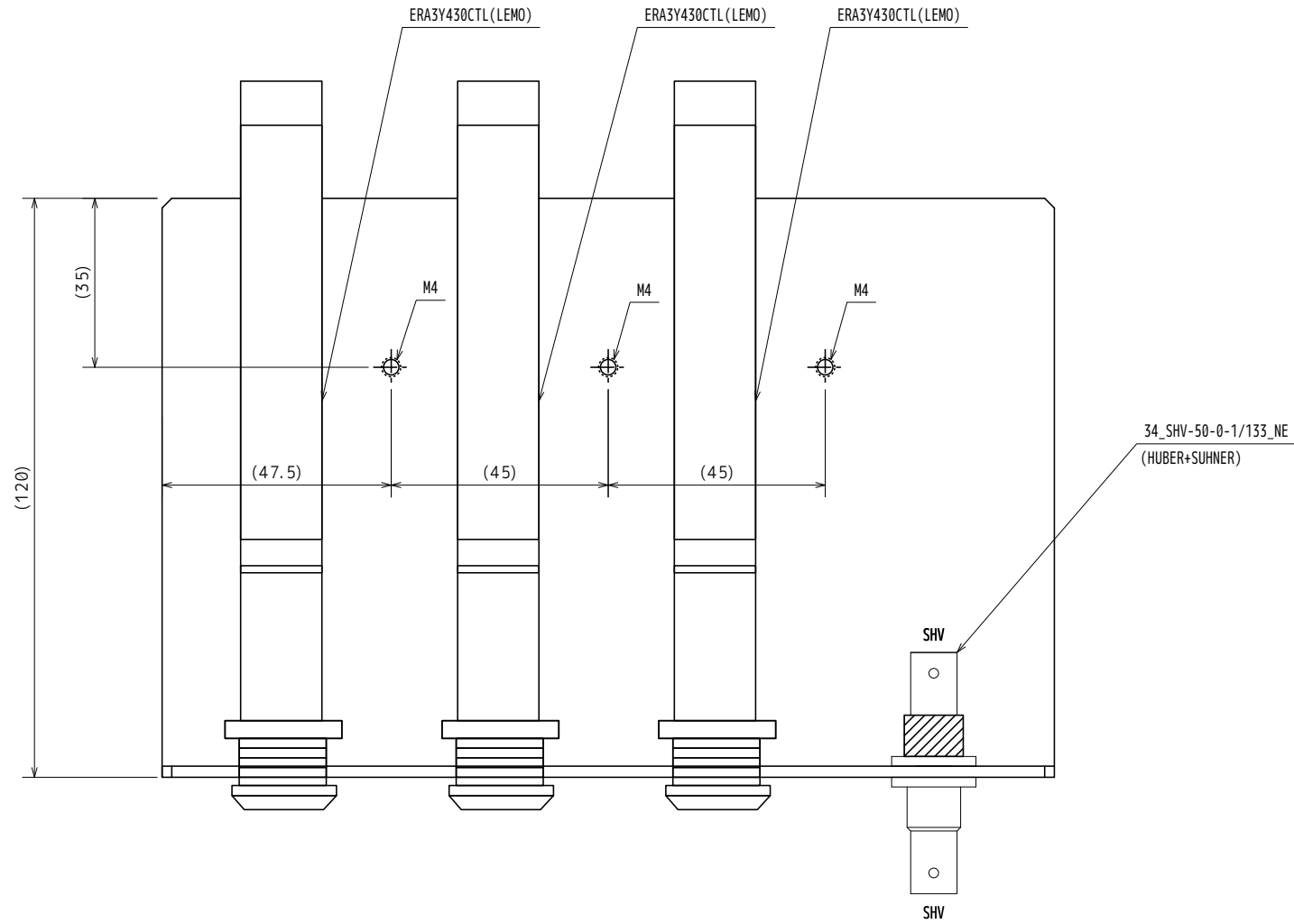
△						RELEASED BY	TITLE
△							Breaker UNIT(CM-PS-BB)
△							SH No. 30
△						Scale	DWG No.
△	REV	DATE	MODIFICATION	APPD/BY	MOD/BY	1 : 5	2AI-00415

APPENDIX IX : Terminal Block Diagram

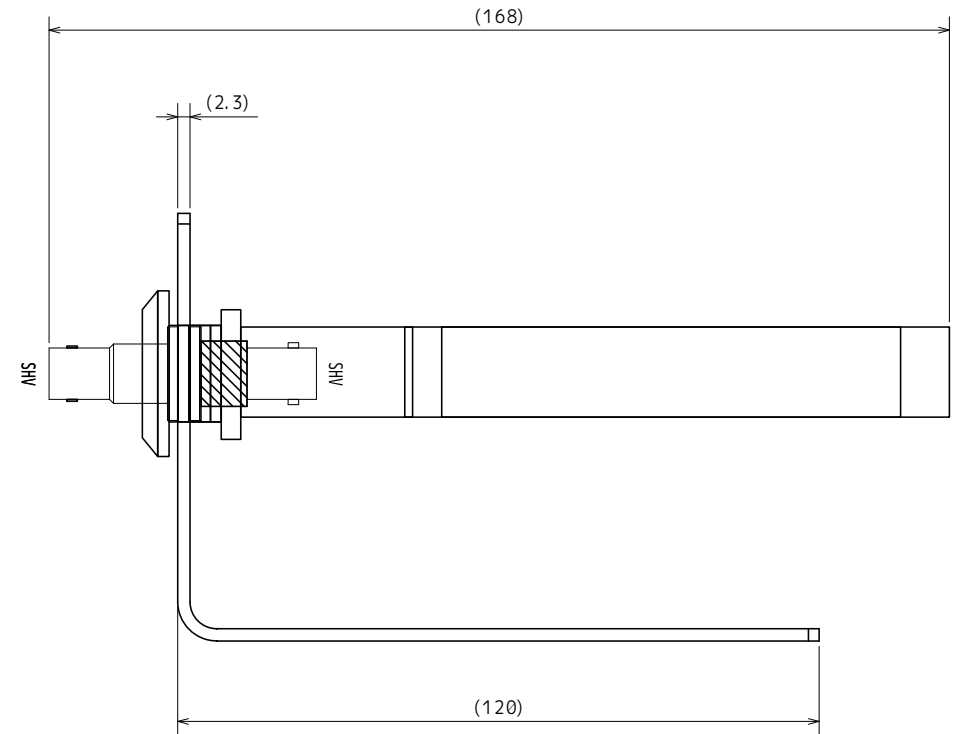


*:This panel is mounted under the PoPola laser table. (Mechanical drawing)

5						RELEASED BY	TITLE
4							
3							Connector Panel
2							SH No. 3 1
1						Scale	DWG No.
REV	DATE	MODIFICATION	APPD/BY	MOD/BY		1:3	3AI-01707 0



HV Connector Panel
SPCC P.C(2.5Y9/1)



*:This panel is mounted under the PoPola laser table. (Mechanical drawing)

△						RELEASED BY	TITLE
△							HV connector Panel
△							SH No. 3 2
△						Scale	DWG No.
△						1 : 1	2AI-00420
REV	DATE	MODIFICATION	APPD/BY	MOD/BY			

APPENDIX X : Component List

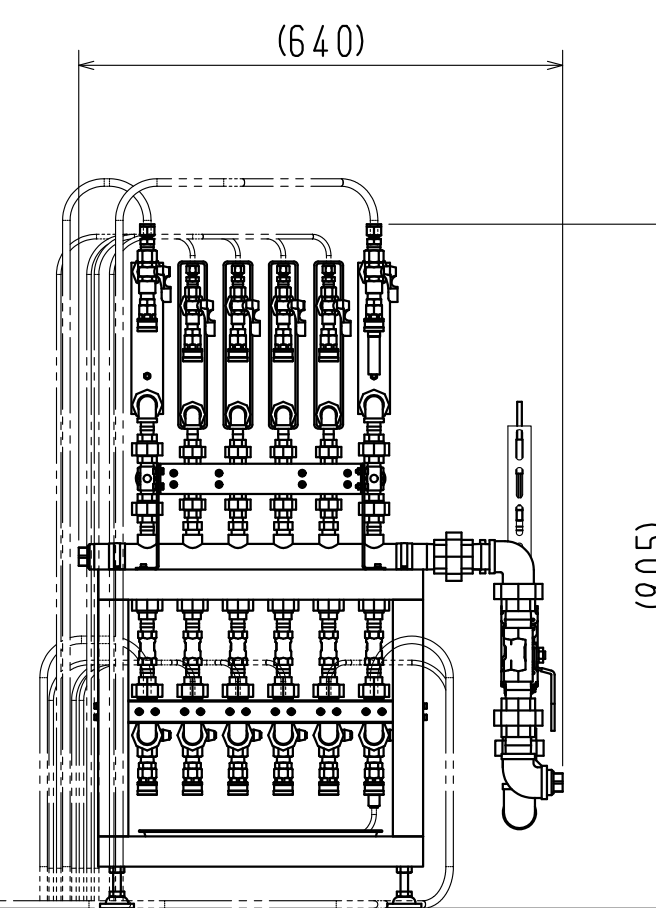
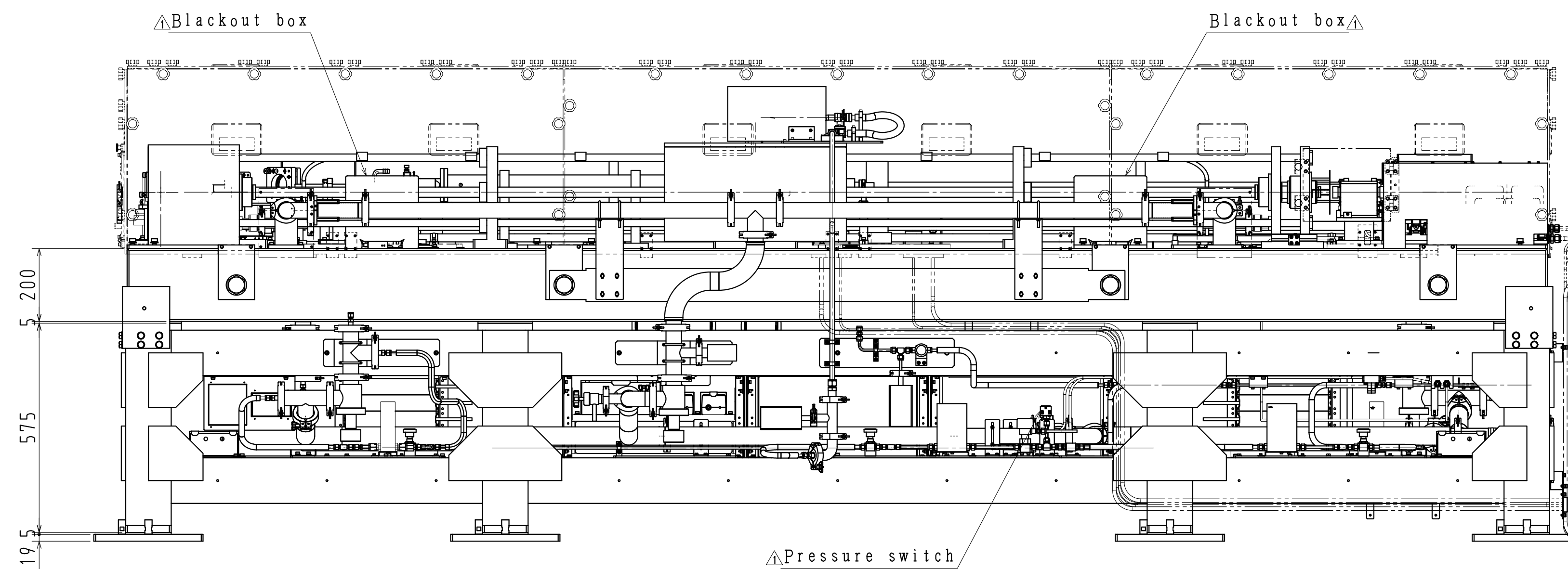
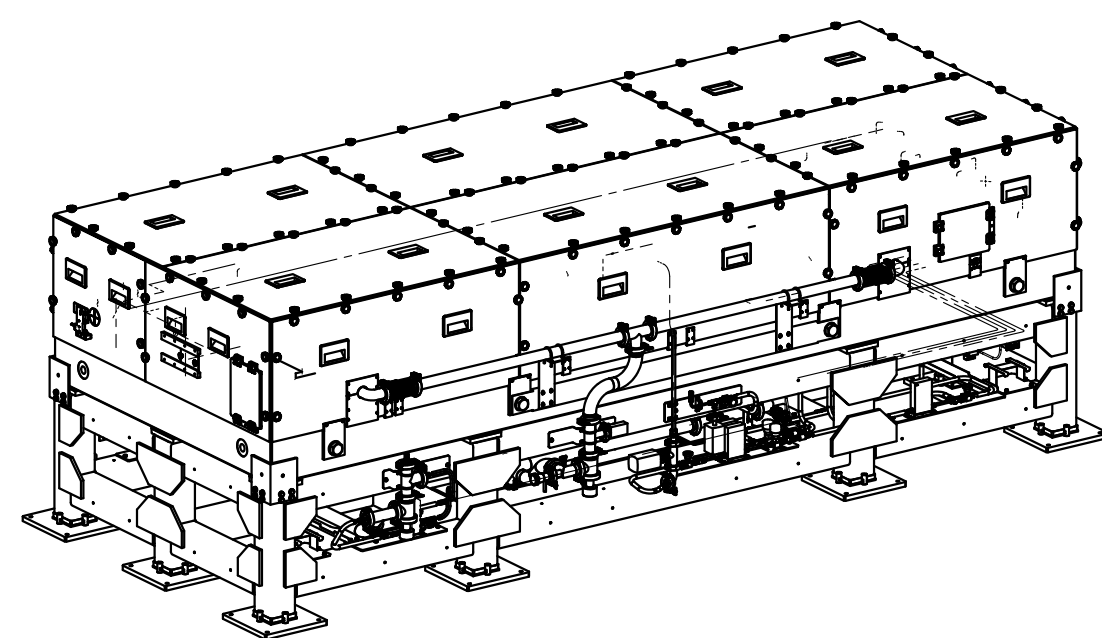
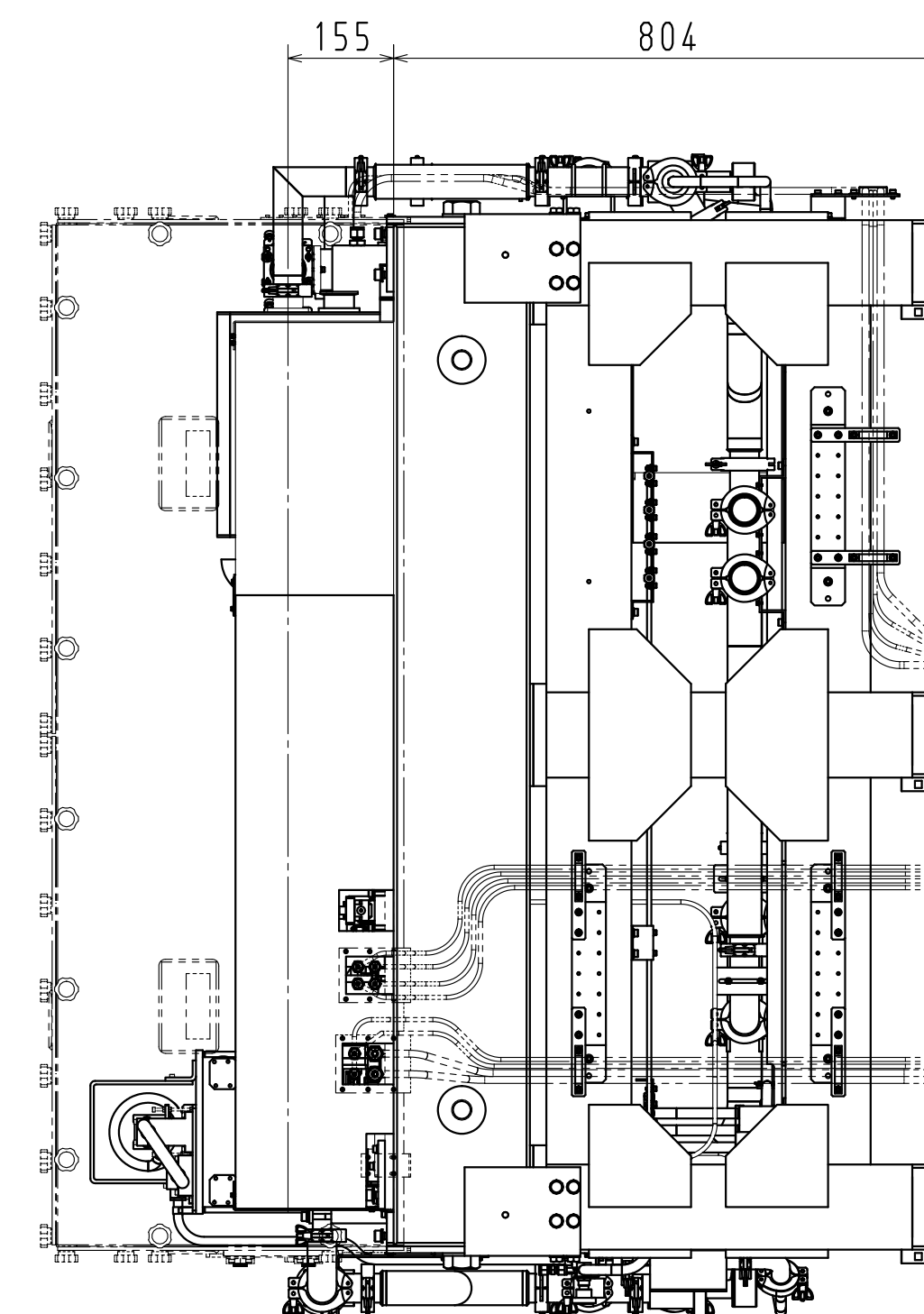
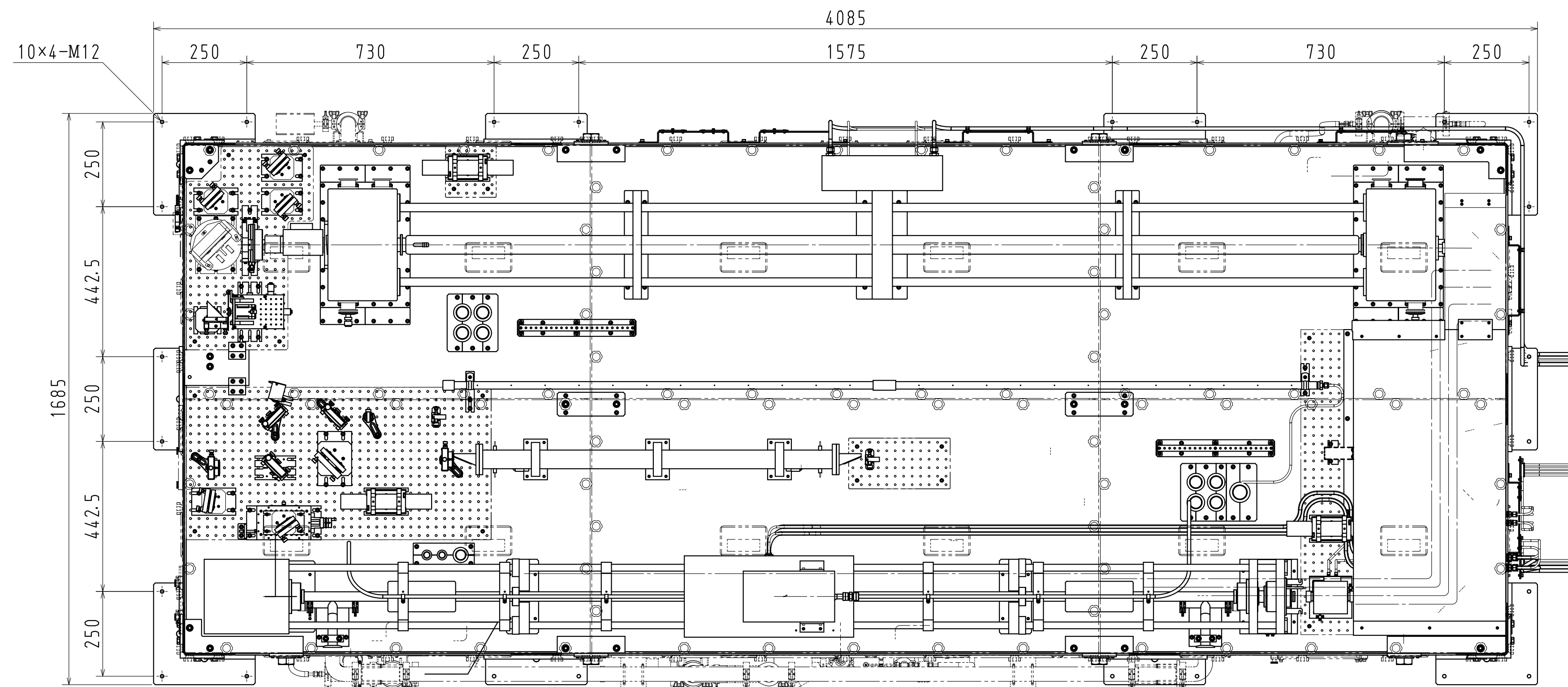
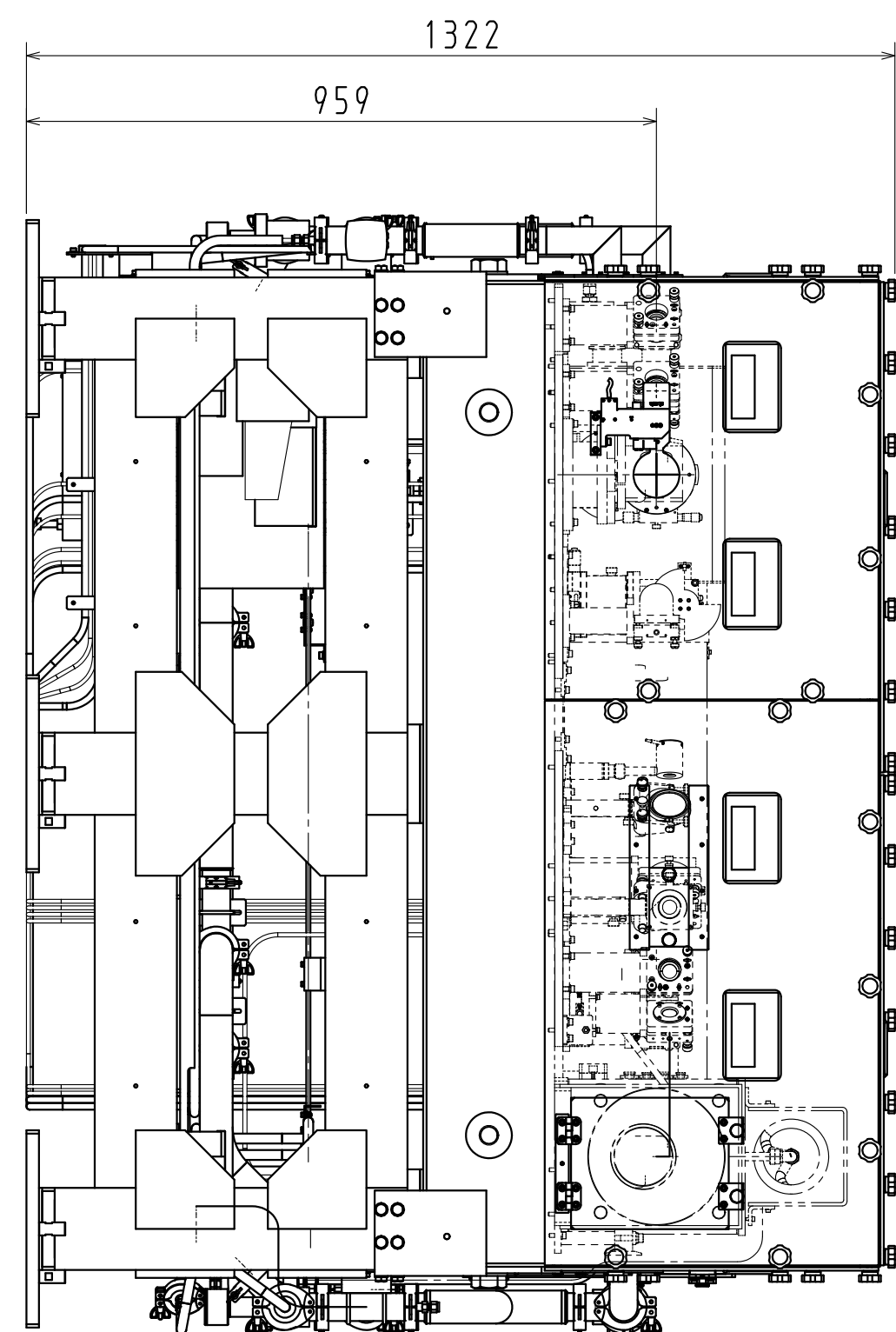
#	Equipment #	Document #	Parts Name	Parts Number	Manufacturer	Notes
101	FL	210693DD-EG-Z002	FIR Laser		SHINSEIKI	
102	FL-IW	210693DD-EG-Z002	FIR Laser Input Window	Zn-Se,17.78×46.23×2.03 Side1:PO/UC, Side2:PO/UC	II-VI Japan	
103	FL-IM	210693DD-EG-Z002	FIR Laser Input Mirror	19.7NCA-00 / OFFSET-HOLE	ULO Optics	Copper Mirror,Gold Coated, ϕ 50×6t, ϕ 3 off-set hole
104	FL-GT	210693DD-EG-Z002	FIR Glass Tube		MEIJO SCIENCE	
105	FL-OM	210693DD-EG-Z002	FIR Laser Output Mirror	Quartz, ϕ 40×2t,119 μ m: Non-reflective coating	Kogakugiken	A disk of crystalline quartz crystal polished by Kogakugiken and coated by Japan Laser.
106	FL-OW	210693DD-EG-Z002	FIR Laser Output Window	Quartz, ϕ 45×1.57t	Kogakugiken	
107	CL	210693DD-EG-Z002	CO2 Laser		KONDO KO-SHA	
108	CL-DG	210693DD-EG-Z002	CO2 Laser Diffraction Grating	G150ML10.6GHA,25x25x10	Optometrics	To use primary light, the grating should be mounted so that the arrow engraved on the grating faces downward.
109	CL-GT1	210693DD-EG-Z002	CO2 Laser Glass Tube	407-905-01-10.8	MEIJO SCIENCE	CL-OW side. Inner diamter: 10.8mm. Length: 1327mm.
110	CL-GT2	210693DD-EG-Z002	CO2 Laser Glass Tube	407-905-02-10.8	MEIJO SCIENCE	CL-DG side. Inner diameter: 10.8mm, Length: 1327mm.
111	CL-OW	210693DD-EG-Z002	CO2 Laser Output Window	ZnSe-M R=20m (凹)	OPTTEC	1"Φ×3t、55% PR/AR
112	C0-SC	210693DD-EG-Z002	Stark cell		KONDO KO-SHA	
113	C0-SA-M	210693DD-EG-Z002	Mirror	MHAN-50.8S-N + PF20-03-M01 +BRS-20-80+RO-20-60+BSP-70120	SIGMAKOKI/Thorlabs	
114	C0-SB-DT	210693DD-EG-Z002	HgCdTe Photovoltaic Detector	PVMI-10.6 + PPS-03-09(20MHz) + VIP-10-20M-S +RS-12-100+TR100/M-JP+BSP-2460	VigoSystem /SIGMAKOKI/Thorlabs	
115	C0-SA-L	210693DD-EG-Z002	Lens(f=200mm)	ALHN-25.4-3RO-N + LA7228-G +RS4P/M+RS25/M+RS2M+CF125C/M	SIGMAKOKI/Thorlabs	
116	C0-SC-L	210693DD-EG-Z002	Lens(f=1000mm)	ALHN-25.4-3RO-N + LA7753-G +RS4P/M+RS25/M+RS2M+CF125C/M	SIGMAKOKI/Thorlabs	
117	C1-ST	210693DD-EG-Z002	Shutter	C-SU + LSC01+4JG-03344-B+4JG-03358-A+4JG-03359-A +WGLS-50-20-12+SNTBS4-10+HFSU4-12	ULO Optics/TOYAMA /MISUMI	
118	C1-PM-M	210693DD-EG-Z002	Movable Mirror	2AE-00929-A	TOYAMA	
119	C1-PM	210693DD-EG-Z002	Power Meter	VEGA/L300W-LP2-50	Ophir	
120	C0-SC-M	210693DD-EG-Z002	Mirror	MHL-50.8S + PF20-03-M01 +4JG-03343-A+4JG-03344-A+4JG03345-A	SIGMAKOKI/Thorlabs/TOYAMA	
121	C0-SC-DT	210693DD-EG-Z002	HgCdTe Photovoltaic Detector	PVMI-10.6 + PPS-03-15(1MHz) + VIP-10-1M-S +RS-12-100+TR100/M-JP+BSP-2460	VigoSystem /SIGMAKOKI/Thorlabs	
122	C0-BS2	210693DD-EG-Z002	Beam Splitter	BHAN-50S-N + BSW720+RS4P/M+RS2M+CF125C/M	SIGMAKOKI/Thorlabs	
123	C0-VL	210693DD-EG-Z002	He-Ne Laser	05LHR111+05-LPL911-065+ HCM2/M +4JG-03340-A +4JG-03346-A +4JG-03350-C	Pacific Lasertec/Thorlabs /TOYAMA	
124	C1-VL	210693DD-EG-Z002	He-Ne Laser	05LHR111+05-LPL911-065+ HCM2/M +4JG-03340-A +4JG-03346-A +4JG-03350-C	Pacific Lasertec/Thorlabs /TOYAMA	
125	C0-VL-M1	210693DD-EG-Z002	Mirror	MHL-25.4S + BB1-E02 +4JG-03349-A+4JG-03350-B+4JG-03351-A	SIGMAKOKI/Thorlabs /TOYAMA	
126	C1-VL-M1	210693DD-EG-Z002	Mirror	MHL-25.4S + BB1-E02 +4JG-03688-A+4JG-03689-A+4JG-03690-A	SIGMAKOKI/Thorlabs /TOYAMA	
127	C1-VL-M2	210693DD-EG-Z002	Movable Mirror	2AE-00928-A	TOYAMA	
128	C0-VL-M2	210693DD-EG-Z002	Movable Mirror	MHL-25.4S + BB1-E02 + TAMC-10161 +4JG-03350-E+4JG-03355-A+4JG-03356-A+4JG-03357-A	SIGMAKOKI/Thorlabs /TOYAMA	
129	FL-DT-BS	210693DD-EG-Z002	Beam Splitter		SHINSEIKI	The prototype of this item crashes with a moter of FL-OM. When manufacturing the product, this item needs to be modified to avoid the clash. - This item is covered by the procurement of FL.
130	C1-M1	210693DD-EG-Z002	Water Cooled Mirror(1)	NiCu plane mirror, ϕ 38×6t, Au coated.	ULO Optics/SHINSEIKI	This item is covered by the procurement of FL.
131	C1-M3	210693DD-EG-Z002	Water Cooled Mirror(3)	NiCu plane mirror, ϕ 38×6t, Au coated.	ULO Optics/SHINSEIKI	This item is covered by the procurement of FL.
132	C1-M4	210693DD-EG-Z002	Water Cooled Mirror(4)	NiCu plane mirror, ϕ 38×6t, Au coated.	ULO Optics/SHINSEIKI	This item is covered by the procurement of FL.
133	C1-M2	210693DD-EG-Z002	Water Cooled Mirror(2)	NiCu concave mirror, ϕ 38×6t, Au coated. (Curvature radius 2m)	ULO Optics/SHINSEIKI	This item is covered by the procurement of FL.
134	C1-BD	210693DD-EG-Z002	Beam Dump	BDU25 +4JG-03326-A+4JG-03327-A+4JG-03328-A+4JG-03329-A	ULO Optics/TOYAMA	
135	FL-VL-M1	210693DD-EG-Z002	Mirror	MHL-25.4S + BB1-E02 +4JG-03346-A+4JG-03348-A+4JG-03350-A	SIGMAKOKI/Thorlabs /TOYAMA	
136	FL-VL-M2	210693DD-EG-Z002	Mirror	MHL-25.4S + BB1-E02 +4JG-03347-A+4JG-03348-A+4JG-03350-A	SIGMAKOKI/Thorlabs /TOYAMA	
137	FL-VL-M3	210693DD-EG-Z002	Mirror	MHL-25.4S + BB1-E02 +4JG-03347-A+4JG-03348-A+4JG-03350-A	SIGMAKOKI/Thorlabs /TOYAMA	

#	Equipment #	Document #	Parts Name	Parts Number	Manufacturer	Notes
138	FL-LP	210693DD-EG-Z002	Polarizer	SPH-80.5-ARS (Custom-made item) +GS57203 +3JG-02519-A+3JG-02520-A+4JG-03330-A+4JG-03331-A +4JG-03332-A	SIGMAKOKI/Specac /TOYAMA	
139	FL-VL	210693DD-EG-Z002	He-Ne Laser	05LHR111+05-LPL911-065+ HCM2/M +4JG-03340-A + 4JG-03346-A + 4JG-03350-C	Pacific Lasertec/Thorlabs /TOYAMA	
140	FL-DT-CP	210693DD-EG-Z002	Optical Chopper	MT16842-3001	Machine Techno	
141	FL-DT-DT	210693DD-EG-Z002	Pyro Detector	QS5-L	Gentec-EO	
142	FL-DT-M	210693DD-EG-Z002	Off-Axis Parabolic Mirror	MHG-MP50.8-NL + #37-308 +4JG-03689-A+4JG-XXXX1-A+4JG-XXXX2-A	SIGMAKOKI/Edmund /TOYAMA	
143	C0-PM	210693DD-EG-Z002	Power Meter	VEGA+2A-BB-9+TR4+PH3T/M+UPHA	Ophir /Thorlabs	
144	C0-BS1	210693DD-EG-Z002	Beam Splitter	BHAN-50S-N + BSW720+RS4P/M+RS2M+CF125C/M	SIGMAKOKI/Thorlabs	
145	C0-SB-L	210693DD-EG-Z002	Lens(f=200mm)	LMR1/M + LA7228-G+PH100E/M+TR75/M-JP+CF125C/M	Thorlabs	
146	FL-ST	210693DD-EG-Z002	FIR Laser Shutter	990-0907 Laser Beam Shutter ϕ 70mm	EKSMA Optics	
147	CL-GT1-PD	210693DD-EG-Z002	CO2 Laser Photo Detector	PDF10A/M + SML30C + Z9902589	Thorlabs/TOYAMA	
148	CL-GT2-PD	210693DD-EG-Z002	CO2 Laser Photo Detector	PDF10A/M + SML30C + Z9902589	Thorlabs/TOYAMA	
149	FL-PM	210693DD-EG-Z002	Power meter	VEGA/3AP-THz	Ophir	
150	C0-SC-GT	210693DD-EG-Z002	Glass Tube for Stark Cell		KONDO KO-SHA	This item is covered by procurement of C0-SC.
151	CL-SP	210693DD-EG-Z002	Spiral glass tube	KUB-11950	Fujikin	
152	CL-TT	210693DD-EG-Z002	T-tube	407-905-13	MEIJO SCIENCE	T-shaped glass tube between CL-GT1 and CL-GT2
153	CL-AN2	210693DD-EG-Z002	Anode (grating side)	(See notes)	KONDO KO-SHA	hole diameter 10 mm. This item is covered by procurement of CL.
154	CL-AN1	210693DD-EG-Z002	Anode (output window side)	(See notes)	KONDO KO-SHA	hole diameter 11 mm. This item is covered by procurement of CL.
155	CL-CS	210693DD-EG-Z002	Cavity support	(See notes)	(See notes)	Rods made of "Zero expansion invar" (Shinhokoku Material Corp) and plastic covers. See details in JADA-5503DW3009.
156	CM-LT	210693DD-EG-Z002	Laser table	2DB-00282	TOYAMA	Material: granite
157	CM-TF	210693DD-EG-Z002	Laser table frame	1DA-00939-A	TOYAMA	
158	CM-CV	210693DD-EG-Z002	Laser enclosure	0AD-00118-A	TOYAMA	This item includes not only frames but also panels.
159	C1-CV	210693DD-EG-Z002	Laser enclosure of C1-laser path	3JG-02932-A	TOYAMA	
201	CL-MG-VP	210693DD-EG-Z003	Dry Roots Pump	nXR90i	Edwards	
202	FL-MG-VP	210693DD-EG-Z003	Dry Roots Pump	nXR90i	Edwards	
203	CL-MG-IV	210693DD-EG-Z003	Isolation Valve	VIV40EKA 208-230V AC/A50637512	Edwards	
204	FL-MG-IV	210693DD-EG-Z003	Isolation Valve	VIV40EKA 208-230V AC/A50637512	Edwards	
205	CL-MG-MV1	210693DD-EG-Z003	Bellows Sealed Valve	SS-4H	Swagelok	
206	FL-MG-MV1	210693DD-EG-Z003	Bellows Sealed Valve	SS-4H	Swagelok	
207	FL-MG-MV3	210693DD-EG-Z003	Bellows Sealed Valve	SS-4H	Swagelok	
208	C0-SC-MV1	210693DD-EG-Z003	Bellows Sealed Valve	SS-4H	Swagelok	
209	C0-SC-MV3	210693DD-EG-Z003	Bellows Sealed Valve	SS-4H	Swagelok	
210	CL-MG-MV2	210693DD-EG-Z003	Bellows Sealed Valve	LBM-NW40DX-1352400	Fuji Technolgy	
211	FL-MG-MV2	210693DD-EG-Z003	O-ring Sealed Valve	LV-NW40DX-1142450	Fuji Technolgy	
212	C0-SC-MV2	210693DD-EG-Z003	O-ring Sealed Valve	LV-NW40DX-1142450	Fuji Technolgy	
213	FL-MG-PV	210693DD-EG-Z003	Piezo Valve	PV-A131-1/4"VCR	HORIBA STEC	
214	C0-MG-PV	210693DD-EG-Z003	Piezo Valve	PV-A131-1/4"VCR	HORIBA STEC	
215	CL-MG-PG1	210693DD-EG-Z003	Capacitance Diaphragm Gauge	3CB5-G61-23G0	INFICON	
216	FL-MG-PG	210693DD-EG-Z003	Capacitance Diaphragm Gauge	3CB5-961-23G0	INFICON	
217	C0-SC-PG	210693DD-EG-Z003	Capacitance Diaphragm Gauge	3CB5-961-23G0	INFICON	
218	CL-MG-GD1	210693DD-EG-Z003	Gauge Controller	VCG503(398-483)	INFICON	
219	CL-NC-MFC	210693DD-EG-Z003	Mass Flow Controller N2 5SLM	SEC-N117MGM,CS5,,MR.MG-06,5SLM,4CRL,N2,	HORIBA STEC	
220	CL-HE-MFC	210693DD-EG-Z003	Mass Flow Controller He 15SLM	SEC-N127MGM,CS5,,MR.MG-07,15SLM,4CRL,He,	HORIBA STEC	
221	FL-HE-MFC	210693DD-EG-Z003	Mass Flow Controller He 10SCCM	SEC-N117MGM,CS5,,MR.MG-R01,10SCCM,4CRL,He,	HORIBA STEC	
222	CL-NC-AV	210693DD-EG-Z003	Bellows Sealed Valve	SS-4BK-1C	Swagelok	
223	CL-HE-AV	210693DD-EG-Z003	Bellows Sealed Valve	SS-4BK-1C	Swagelok	
224	CL-NC-FT	210693DD-EG-Z003	Filter	SS-4F-05	Swagelok	
225	CL-HE-FT	210693DD-EG-Z003	Filter	SS-4F-05	Swagelok	
226	CL-MG-PG2	210693DD-EG-Z003	Pirani Gauge	3PI1-006-41G0	INFICON	
227	CL-MG-GD2	210693DD-EG-Z003	Pirani Gauge Display	PGD500(398-802)	INFICON	

#	Equipment #	Document #	Parts Name	Parts Number	Manufacturer	Notes
228	CL-MG-MV3	210693DD-EG-Z003	Inlet Valve NW25	951-7178	ANELVA	
229	F*-FL-AV	210693DD-EG-Z003	Actuated Valve	part of CH3OH Vaporization System(55C600-DIA-0001)	HORIBA STEC	*: A, U or B
230	F*-SC-AV	210693DD-EG-Z003	Actuated Valve	part of CH3OH Vaporization System(55C600-DIA-0001)	HORIBA STEC	*: A, U or B
231	F*-FL-MFC	210693DD-EG-Z003	Mass Flow Controller	part of CH3OH Vaporization System(55C600-DIA-0001)	HORIBA STEC	*: A, U or B
232	F*-SC-MFC	210693DD-EG-Z003	Mass Flow Controller	part of CH3OH Vaporization System(55C600-DIA-0001)	HORIBA STEC	*: A, U or B
233	55C600-DIA-0001	210693DD-EG-Z003	CH3OH Vaporization System	LSC-7900-00004	HORIBA STEC	Parts Number is that of the prototype (for one laser unit). For safety reasons, the contact signal output should be changed from contact A to contact B (ON successfully, OFF abnormally) when the actual laser system is manufactured.
234	CM-SV	210693DD-EG-Z004	Manifold, 3-port Solenoid Valves and Silencer	SS3YJ3-S42-02-M5-Q + 2 × SYJ314-5GZD-Q + AN101-01	SMC	
235	CM-CW-WM1	210693DD-EG-Z005	Manifold	SUMHAF25A-6-P60-S90-Q70	MISUMI	
236	CM-CW-WM2	210693DD-EG-Z005	Manifold	SUMHAF25A-6-P60-S90-Q70	MISUMI	
237	CM-CW-MV0	210693DD-EG-Z005	Ball Valve	UTK-25A	KITZ	
238	CL-CW-MV1a	210693DD-EG-Z005	Needle Valve	NBPPS33	MISUMI	
239	FL-CW-MV2a	210693DD-EG-Z005	Needle Valve	NBPPS33	MISUMI	
240	CL-CW-MV2a	210693DD-EG-Z005	Needle Valve	NBPPS22	MISUMI	
241	CL-CW-MV3a	210693DD-EG-Z005	Needle Valve	NBPPS22	MISUMI	
242	CL-CW-MV4a	210693DD-EG-Z005	Needle Valve	NBPPS22	MISUMI	
243	FL-CW-MV1a	210693DD-EG-Z005	Needle Valve	NBPPS22	MISUMI	
244	CL-CW-MV1d	210693DD-EG-Z005	Ball Valve	UTKW-10A	KITZ	
245	CL-CW-MV2d	210693DD-EG-Z005	Ball Valve	UTKW-10A	KITZ	
246	CL-CW-MV3d	210693DD-EG-Z005	Ball Valve	UTKW-10A	KITZ	
247	CL-CW-MV4d	210693DD-EG-Z005	Ball Valve	UTKW-10A	KITZ	
248	FL-CW-MV1d	210693DD-EG-Z005	Ball Valve	UTKW-10A	KITZ	
249	FL-CW-MV2d	210693DD-EG-Z005	Ball Valve	UTKW-10A	KITZ	
250	CL-CW-FM2	210693DD-EG-Z005	Flow Meter	KZ-7003-09L	AS ONE	
251	CL-CW-FM3	210693DD-EG-Z005	Flow Meter	KZ-7003-09L	AS ONE	
252	CL-CW-FM4	210693DD-EG-Z005	Flow Meter	KZ-7003-09L	AS ONE	
253	FL-CW-FM1	210693DD-EG-Z005	Flow Meter	KZ-7003-09L	AS ONE	
254	CL-CW-FM1	210693DD-EG-Z005	Flow Meter	RK2000-VD-S-H2O-10L/MIN-0.2MPa-0.1MPa	KOFLOC	
255	FL-CW-FM2	210693DD-EG-Z005	Flow Meter	RK2000-VD-S-H2O-10L/MIN-0.2MPa-0.1MPa	KOFLOC	
256	CM-WL	210693DD-EG-Z005	Liquid Leakage Sensor	K7L-UB/P2RF-08-PU+F03-16PE+F03-26PES+F03-20	OMRON	
257	CM-CW-TS0	210693DD-EG-Z005	Resistance Temperature Detector	PTR3531-ClassA	HAKKO ELECTRIC	
258	CM-CW-FM0	210693DD-EG-Z005	Clamp-on Flow Sensor	FD-H20	KEYENCE	
259	CL-CW-MV1b	210693DD-EG-Z005	3-port Valve	BT-2333	MISUMI	
260	FL-CW-MV2b	210693DD-EG-Z005	3-port Valve	BT-2333	MISUMI	
261	CL-CW-MV1c	210693DD-EG-Z005	3-port Valve	BT-2333	MISUMI	
262	CL-CW-MV2c	210693DD-EG-Z005	3-port Valve	BT-2333	MISUMI	
263	CL-CW-MV3c	210693DD-EG-Z005	3-port Valve	BT-2333	MISUMI	
264	CL-CW-MV4c	210693DD-EG-Z005	3-port Valve	BT-2333	MISUMI	
265	FL-CW-MV1c	210693DD-EG-Z005	3-port Valve	BT-2333	MISUMI	
266	FL-CW-MV2c	210693DD-EG-Z005	3-port Valve	BT-2333	MISUMI	
267	CL-CW-MV2b	210693DD-EG-Z005	3-port Valve	BT-1222	MISUMI	
268	CL-CW-MV3b	210693DD-EG-Z005	3-port Valve	BT-1222	MISUMI	
269	CL-CW-MV4b	210693DD-EG-Z005	3-port Valve	BT-1222	MISUMI	
270	FL-CW-MV1b	210693DD-EG-Z005	3-port Valve	BT-1222	MISUMI	
271	55C6FA-HX-0002	210693DD-EG-Z005	Heat exchanger	TF-10000	ThermoFlex	Water-cooled Chiller (Secondary water is cooling water supplied from the building)
272	55C6FB-HX-0002	210693DD-EG-Z005	Heat exchanger	TF-10000	ThermoFlex	Water-cooled Chiller (Secondary water is cooling water supplied from the building)
273	55C6FU-HX-0002	210693DD-EG-Z005	Heat exchanger	TF-10000	ThermoFlex	Water-cooled Chiller (Secondary water is cooling water supplied from the building)
274	CL-NC-PG	210693DD-EG-Z003	Digital Pressure Switch(Gauge)	ISE20C-T-M-B2-W	SMC	
275	CL-HE-PG	210693DD-EG-Z003	Digital Pressure Switch(Gauge)	ISE20C-T-M-B2-W	SMC	
301	C0-SA	210693DD-EG-Z007-011	Spectrum analyzer	16A + 4JJ-09432-A + PLSBG17-96-M6-N8	MackenInstruments/TOYAMA/ MISUMI	
302	C0-SB-OM	210693DD-EG-Z007-011	Output Monitor + CO2 Differential amplifier(× 10)	(3A07742)	GIGA	Rack mountable with fixed 10x amplification to 3A07742

#	Equipment #	Document #	Parts Name	Parts Number	Manufacturer	Notes
303	C0-SC-LA	210693DD-EG-Z007-011	Lock-in amplifier	LIA-MV-150-S	OPTO SCIENCE	
304	C0-SC-PS	210693DD-EG-Z007-011	HighSpeedHighVoltage AMP	HAP-10B10	Matsusada Precision	
305	C1-CV-SW	210693DD-EG-Z007-011	Cover switch	SS-5GL2	OMRON	
306	CL-HV	210693DD-EG-Z007-011	CO2 laser PS	IPN-20K200-M	IDX	
307	CL-MG-VS	210693DD-EG-Z007-011	Vacuum pump SWBOX	3AI-01382-A	TOYAMA	
308	CL-OS	210693DD-EG-Z007-011	CO2 Oscilloscope	MDO34 3-BW-100	Tektronix	
309	CL-OW-PD/PT	210693DD-EG-Z007-011	Piezo driver/Potention mater	3AI-01709-A	TOYAMA	
310	CL-OW-PZ	210693DD-EG-Z007-011	Piezo Actuator	MAP-G1-OS	MESS-TEK	
311	CM-EI	210693DD-EG-Z007-011	External Interlock	N/A	N/A	Contact signals to/from slow controller(Monitoring PLC)
312	CM-EP	210693DD-EG-Z007-011	Ethernet Patch Panel	NR21326B	Panasonic	
313	CM-MD1	210693DD-EG-Z007-011	Oscilloscope Monitor(CL-OS)	22MN430M-BAJP	LG	
314	CM-MD2	210693DD-EG-Z007-011	Oscilloscope Monitor(FL-OS)	22MN430M-BAJP	LG	
315	CM-PB	210693DD-EG-Z007-011	Panic button	EBB-2402-DA	MISUMI	
316	CM-PLC1	210693DD-EG-Z007-011	PLC UNIT#1	3AI-01704-A	TOYAMA	
317	CM-PLC2	210693DD-EG-Z007-011	PLC UNIT#2	2AI-00418-A	TOYAMA	
318	CM-PS-BB	210693DD-EG-Z007-011	Breaker UNIT	2AI-00415-A	TOYAMA	
319	CM-SH	210693DD-EG-Z007-011	Ethernet Hub	W4S1-05D	OMRON	
320	CM-TH	210693DD-EG-Z007-011	Thermo hygrometer	ZN-THX21-S	OMRON	
321	CM-TP	210693DD-EG-Z007-011	Touch Panel	NA5-15W101S-V1	OMRON	
322	FL-DT-AM	210693DD-EG-Z007-011	FIR Diff Amp	5307	NF CORPORATION	
323	FL-DT-LA	210693DD-EG-Z007-011	Lock-in Amplifier	LIA-MV-150-S	OPTO SCIENCE	
324	FL-MG-VS	210693DD-EG-Z007-011	Vacuum pump SWBOX	3AI-01382-A	TOYAMA	
325	FL-OM-CB	210693DD-EG-Z007-011	FIR Stage Controller	200544DD-2	koyo	
326	FL-OS	210693DD-EG-Z007-011	FIR Oscilloscope	MDO34 3-BW-100	Tektronix	
327	CM-CC1	210693DD-EG-Z007-011	Control cabinet #1	(TOYAMA Standard Cabinet)	HUMAN	Cabinet to store PLC etc.
328	CM-CC2	210693DD-EG-Z007-011	Control cabinet #2	(TOYAMA Standard Cabinet)	HUMAN	Cabinet to store Transformer etc.
329	CM-TR1	210693DD-EG-Z007-011	Transformer (3 phase, 7.5 kVA)	TRP7.5K-42Y	TOYOGIKEN	3 phase, 7.5 kVA, to convert 400 V into 200 V
330	CM-TR2	210693DD-EG-Z007-011	Transformer (1 phase, 1 kVA)	TRP1K-41S	TOYOGIKEN	1 phase, 1 kVA, to convert 230 V into 100 V
331	C0-SC-WG	210693DD-EG-Z007-011	Oscillator (Sin Wave Generator)	AD8626	AandD	

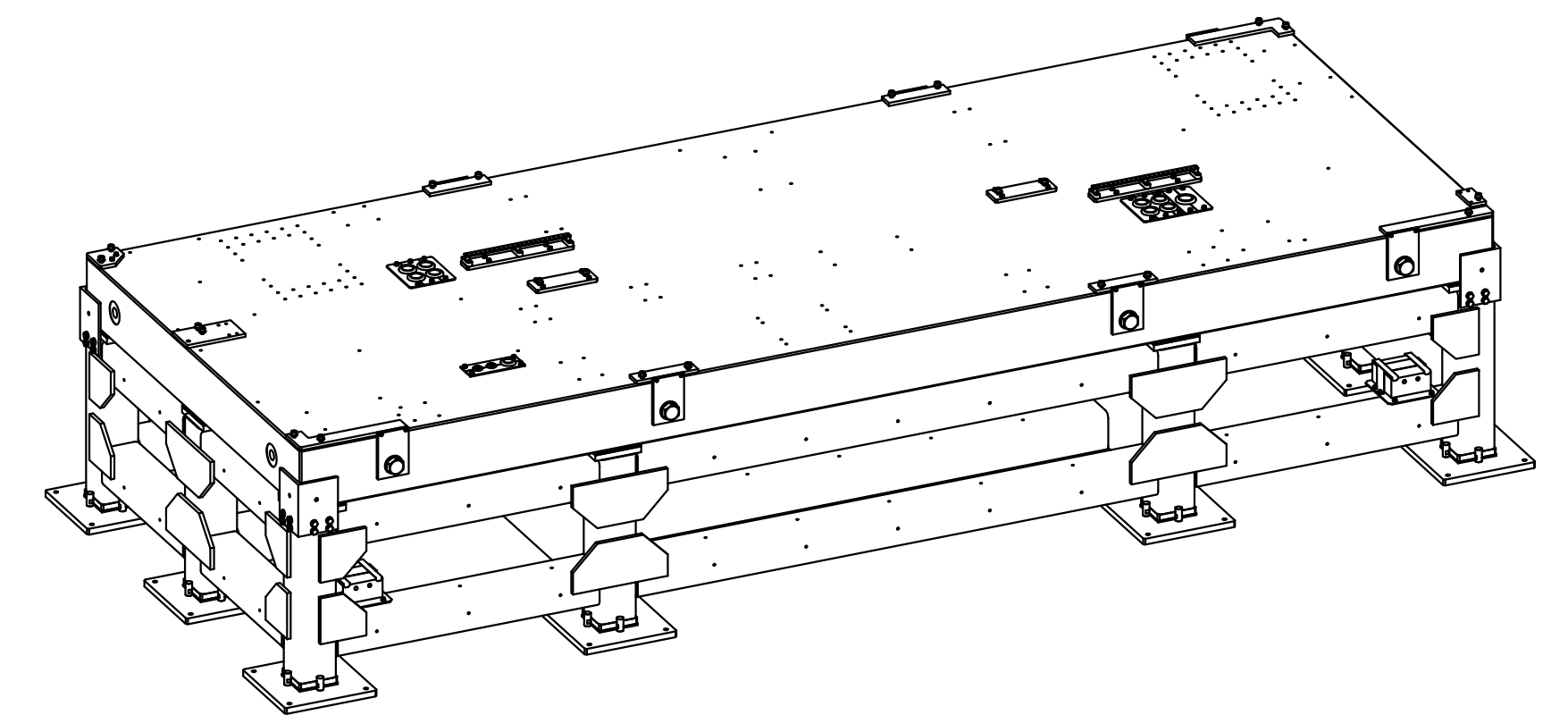
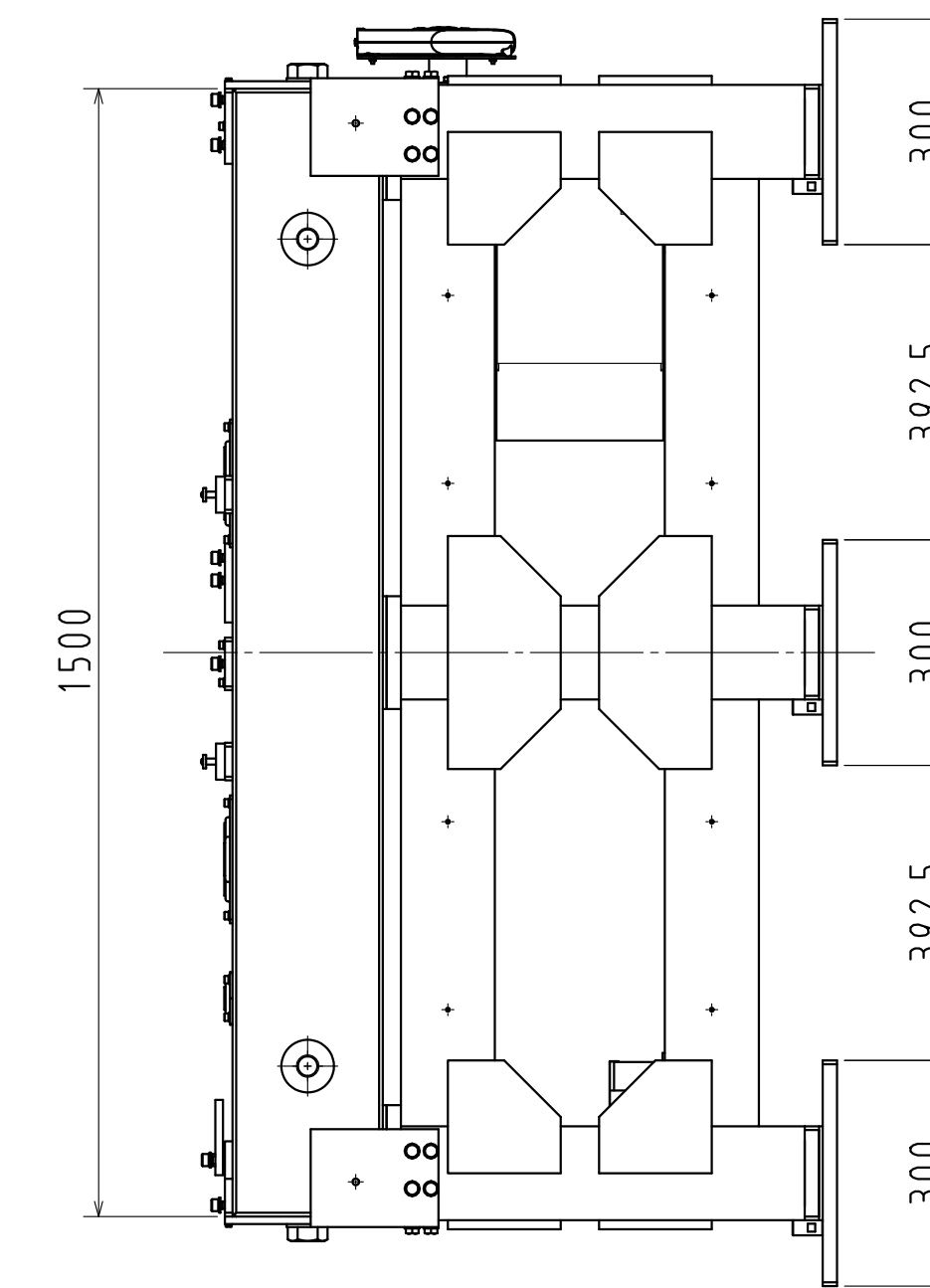
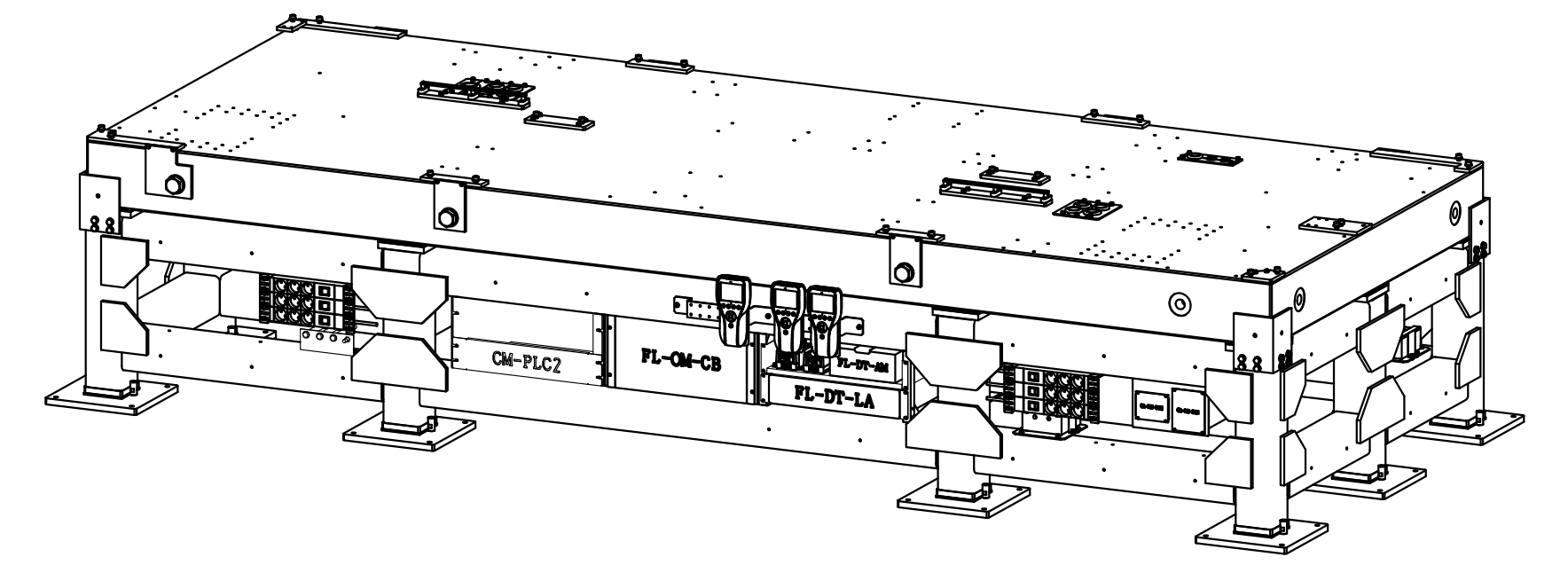
APPENDIX XI : Mechanical Drawing



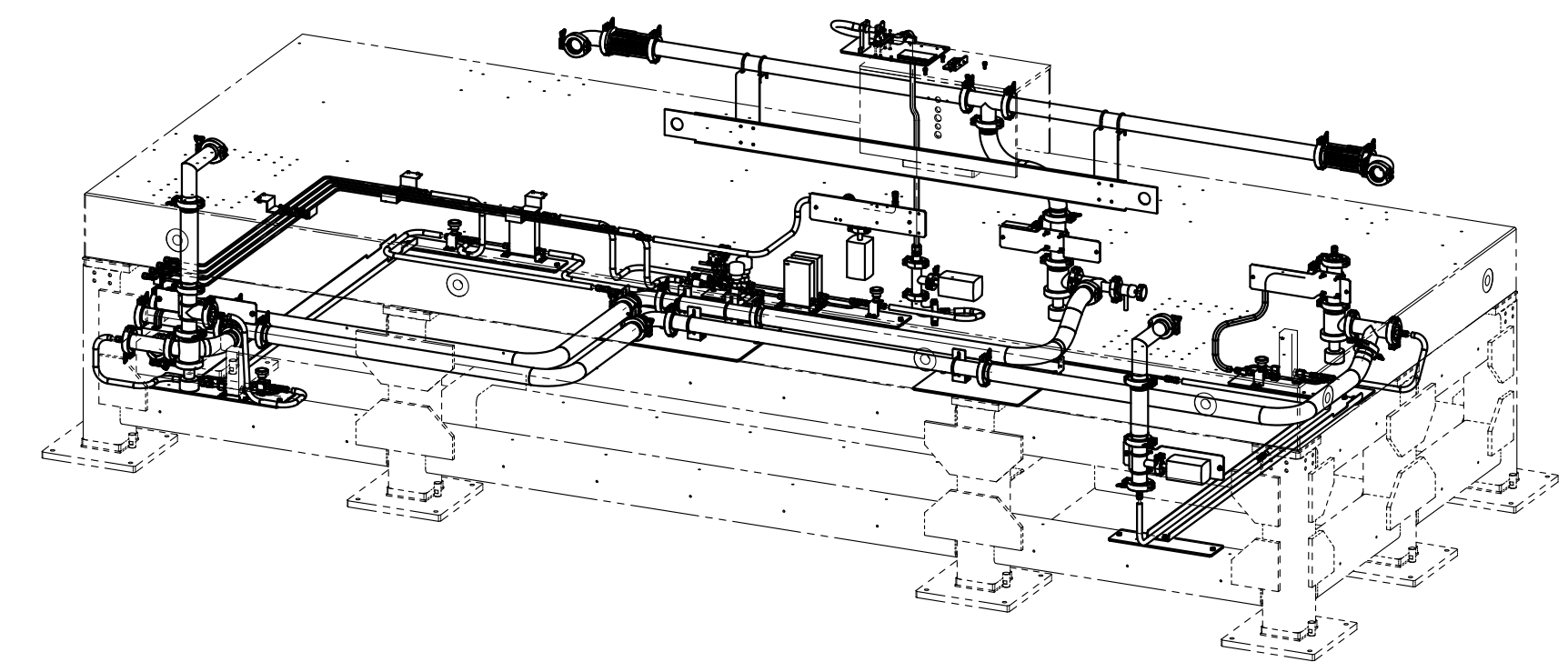
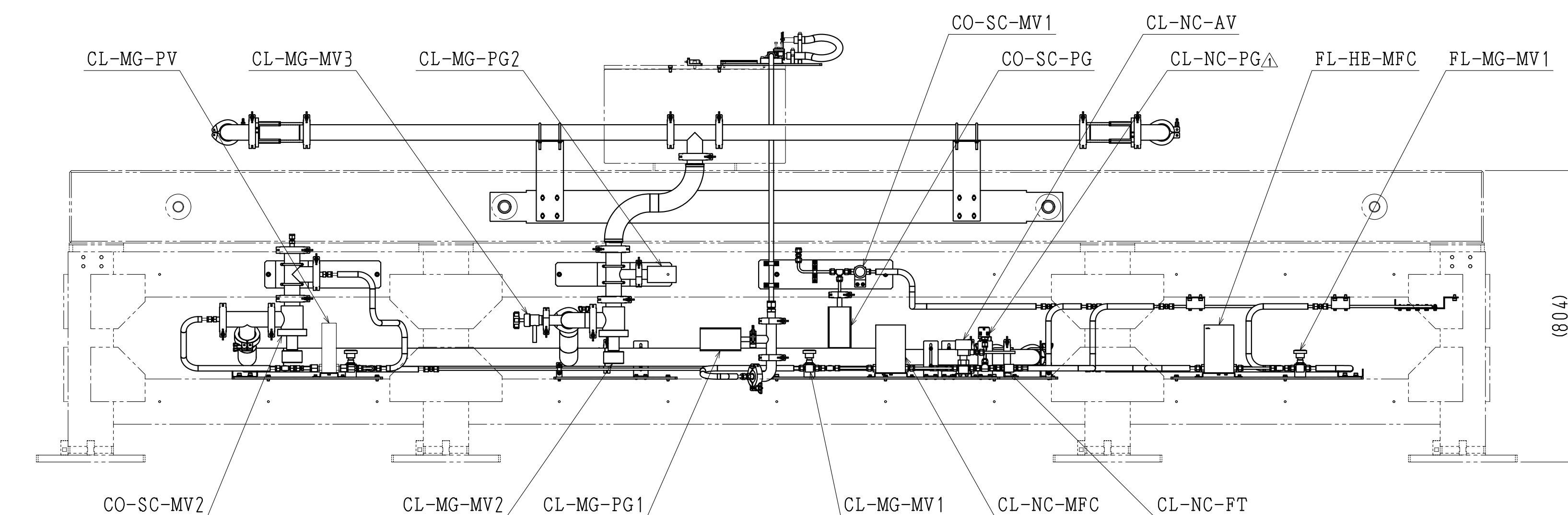
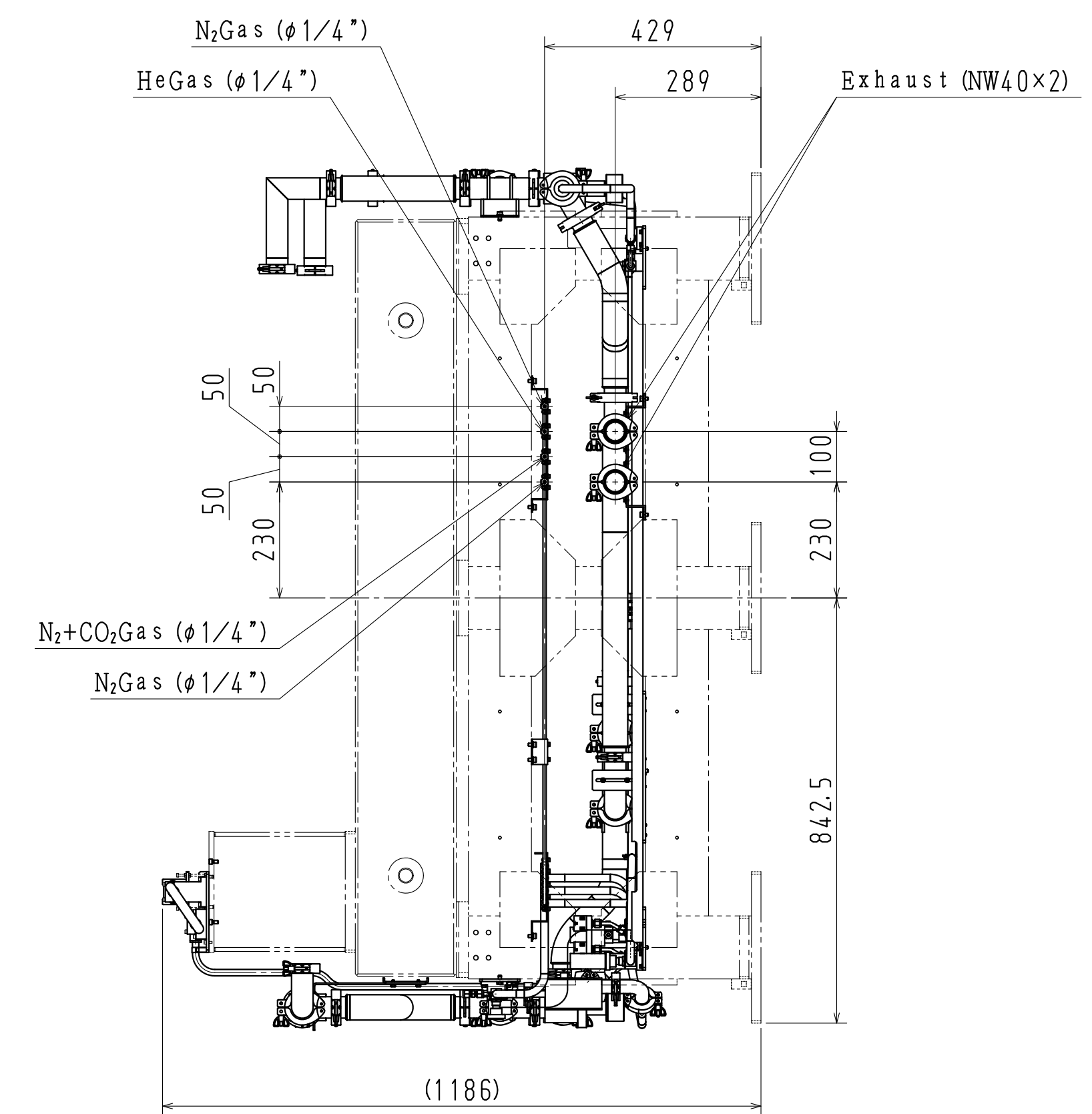
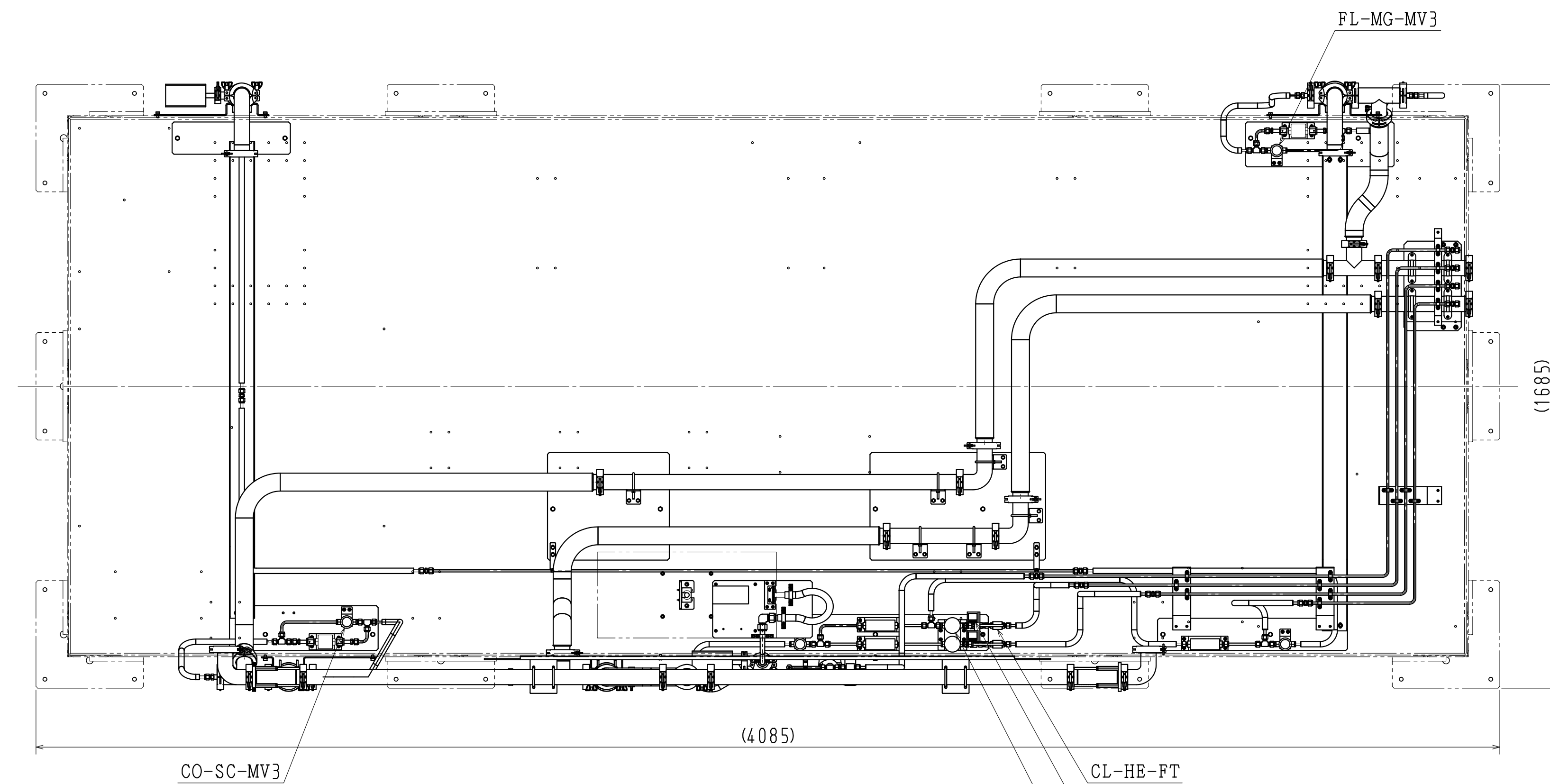
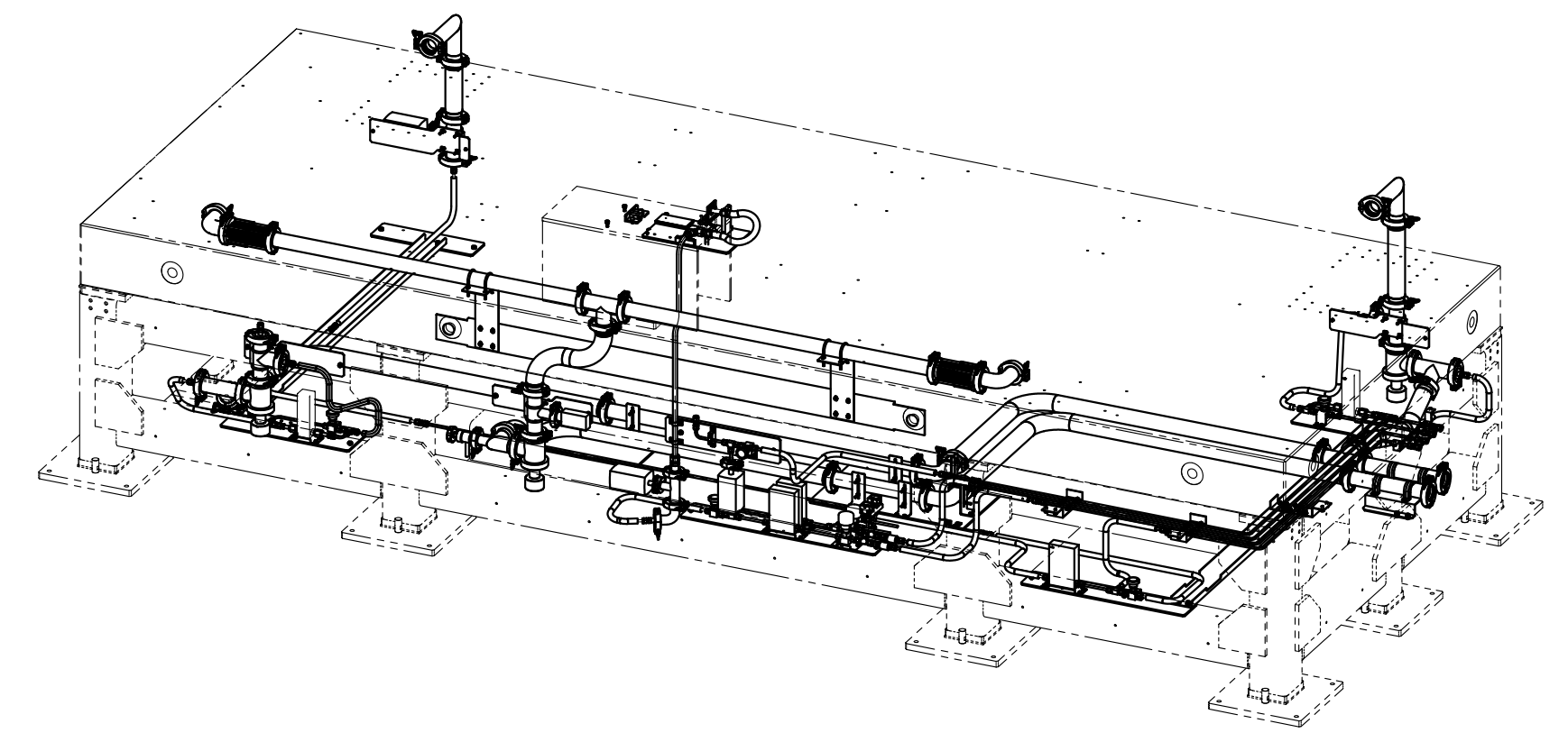
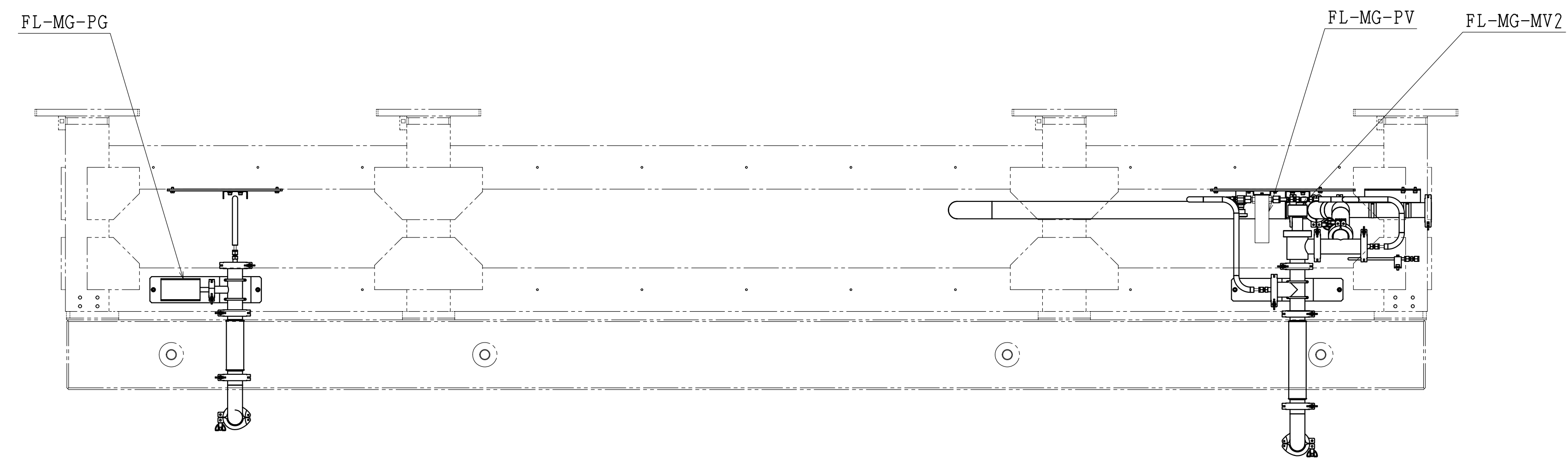
Weight: 5.3[ton]

4			
3			
2			
1	Changing the Blackout box, add Pressure switch	20/Feb/2023	
REV	MODIFICATION	DATE	MOD/BY

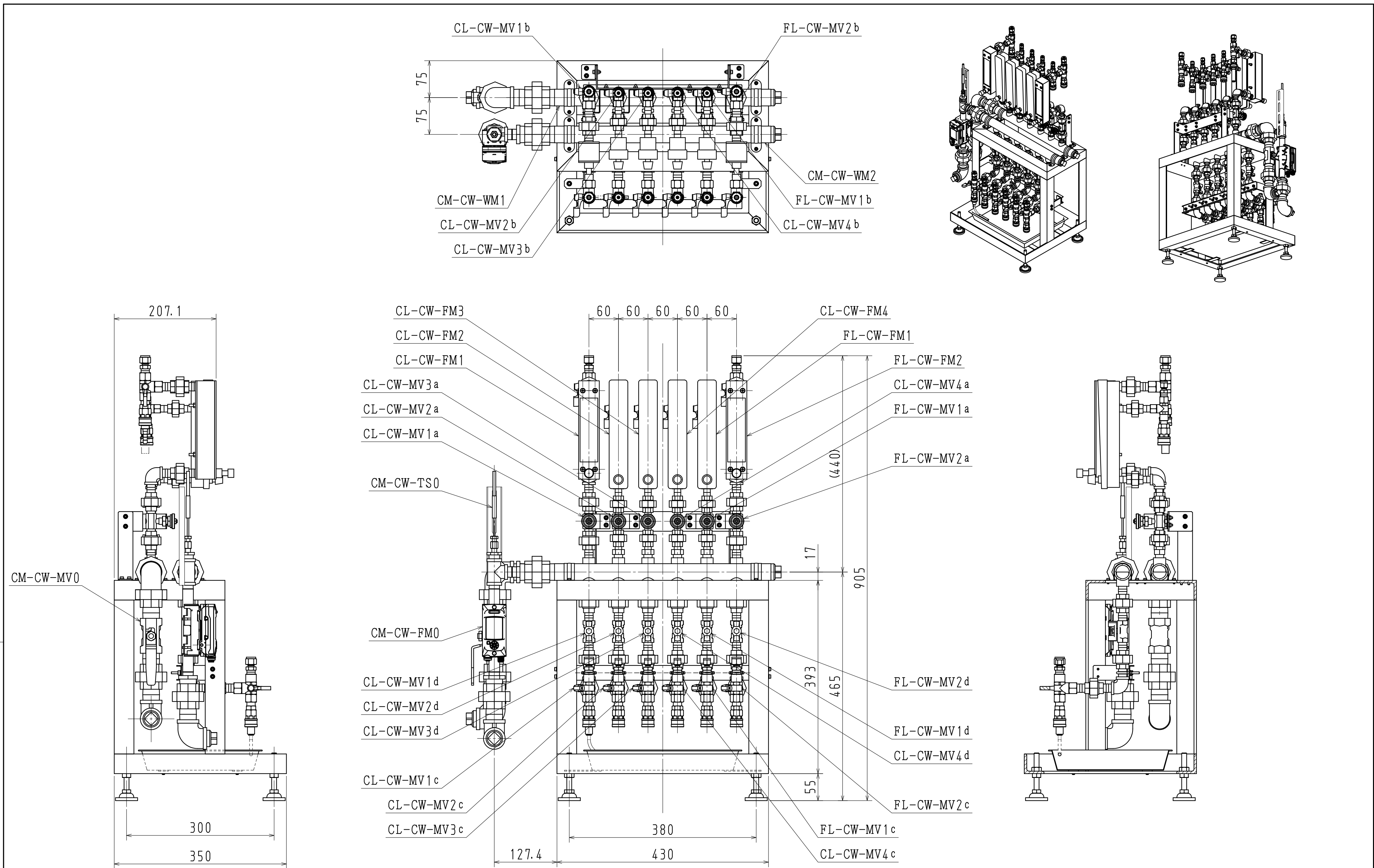
UNIT: mm	TITLE
	FIR Laser
SCALE	Mechanical Drawings
DWG No.	1AA-00090
1:10	



4					UNIT: mm	TITLE	 FIR Laser Structure Assy	
3					 SCALE	DWG No.		
2						1:10		1AD-00504
1								
REV	MODIFICATION	DATE	MOD/BY					



4				UNIT: mm	TITLE
3					<i>FIR Laser</i>
2					<i>Vacuum Diagram Assy</i>
1	Add Pressure switch	20/Feb/2023		SCALE	DWG No.
REV	MODIFICATION	DATE	MOD/BY	1:10	1AJ-00652



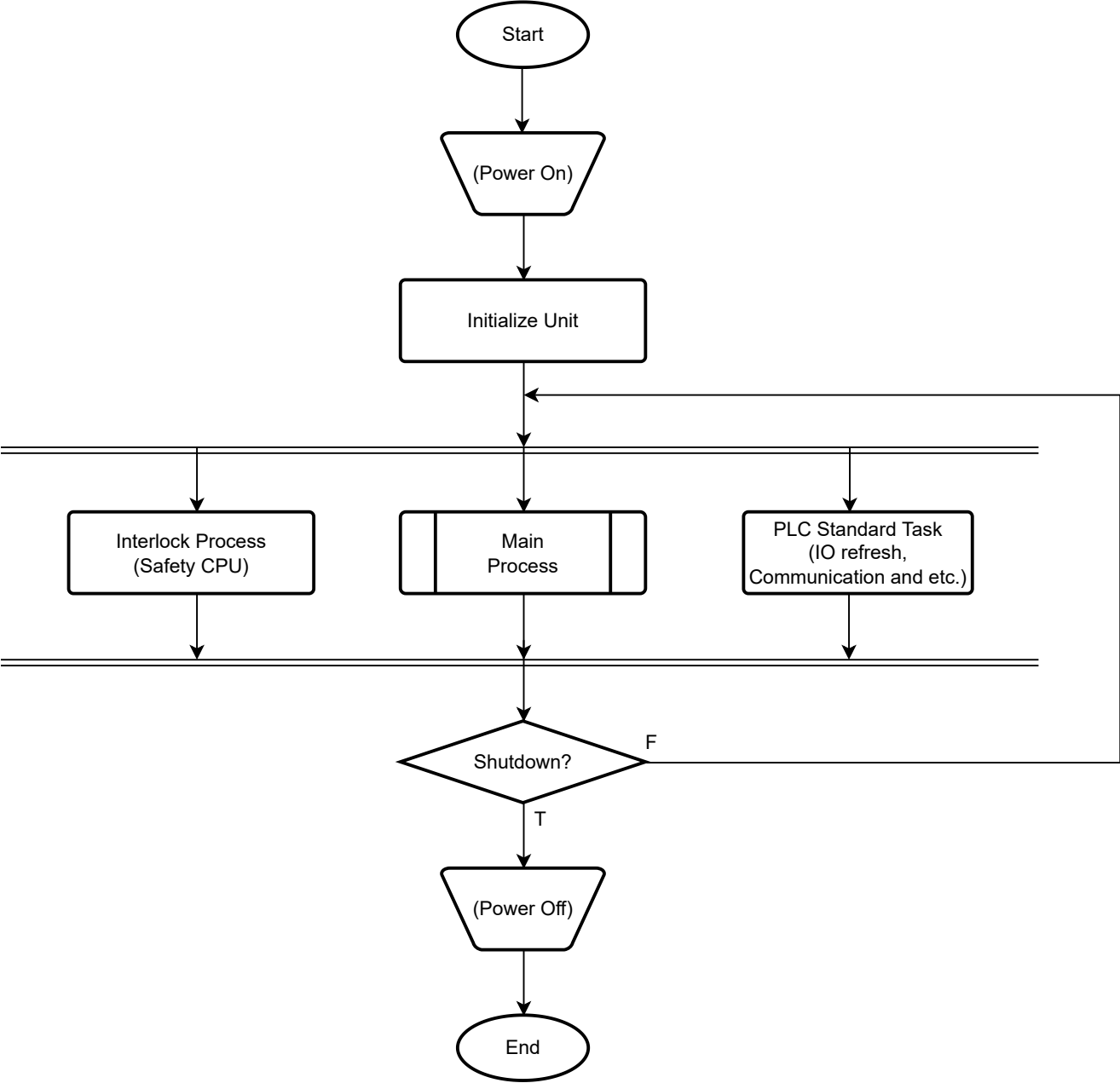
CM-CW-MV0

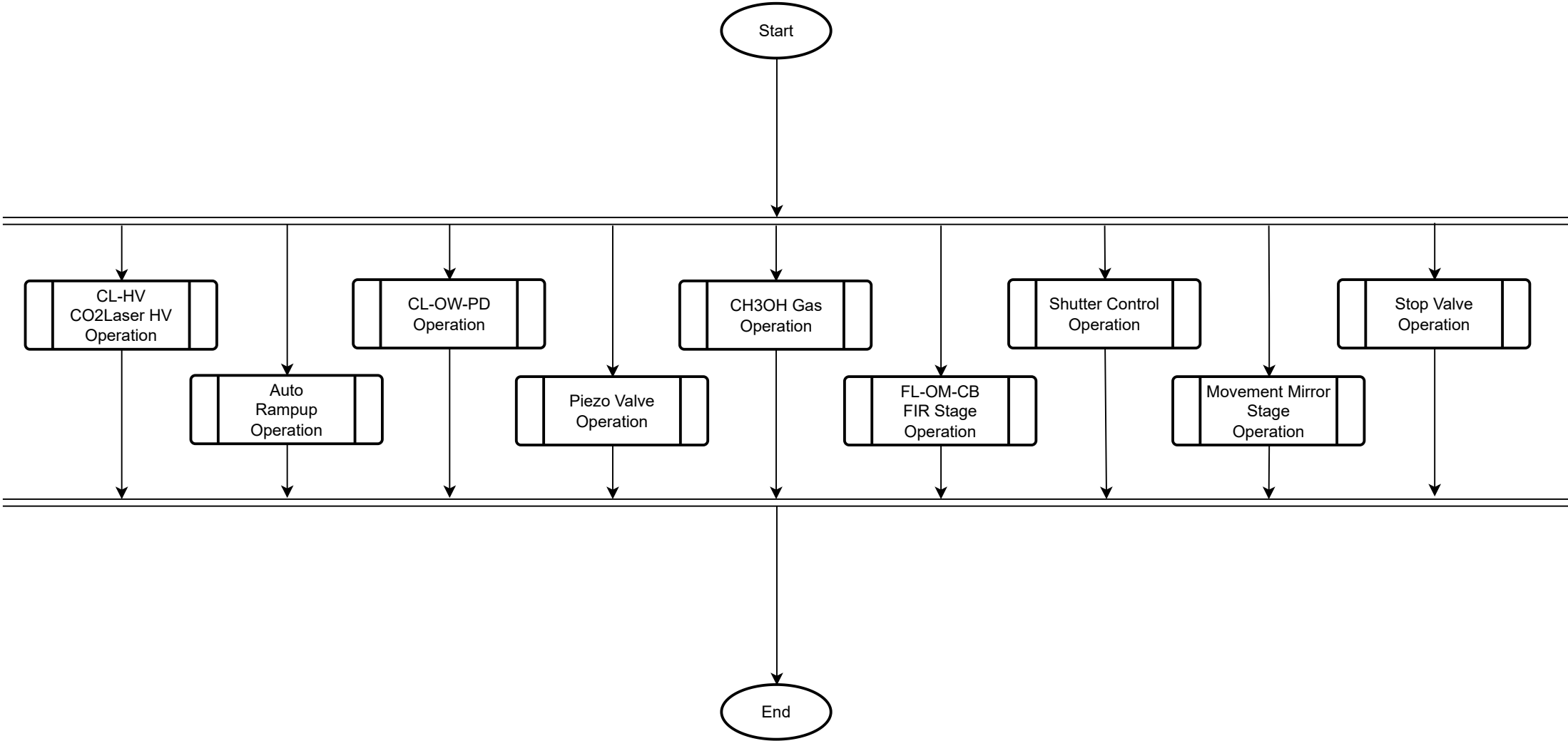
4				UNIT: mm TITLE FIR Laser Manifold Assy	SCALE 1:5	DWG No. 2AJ-01089	ICAD
3							
2							
1							
REV	MODIFICATION	DATE	MOD/BY				

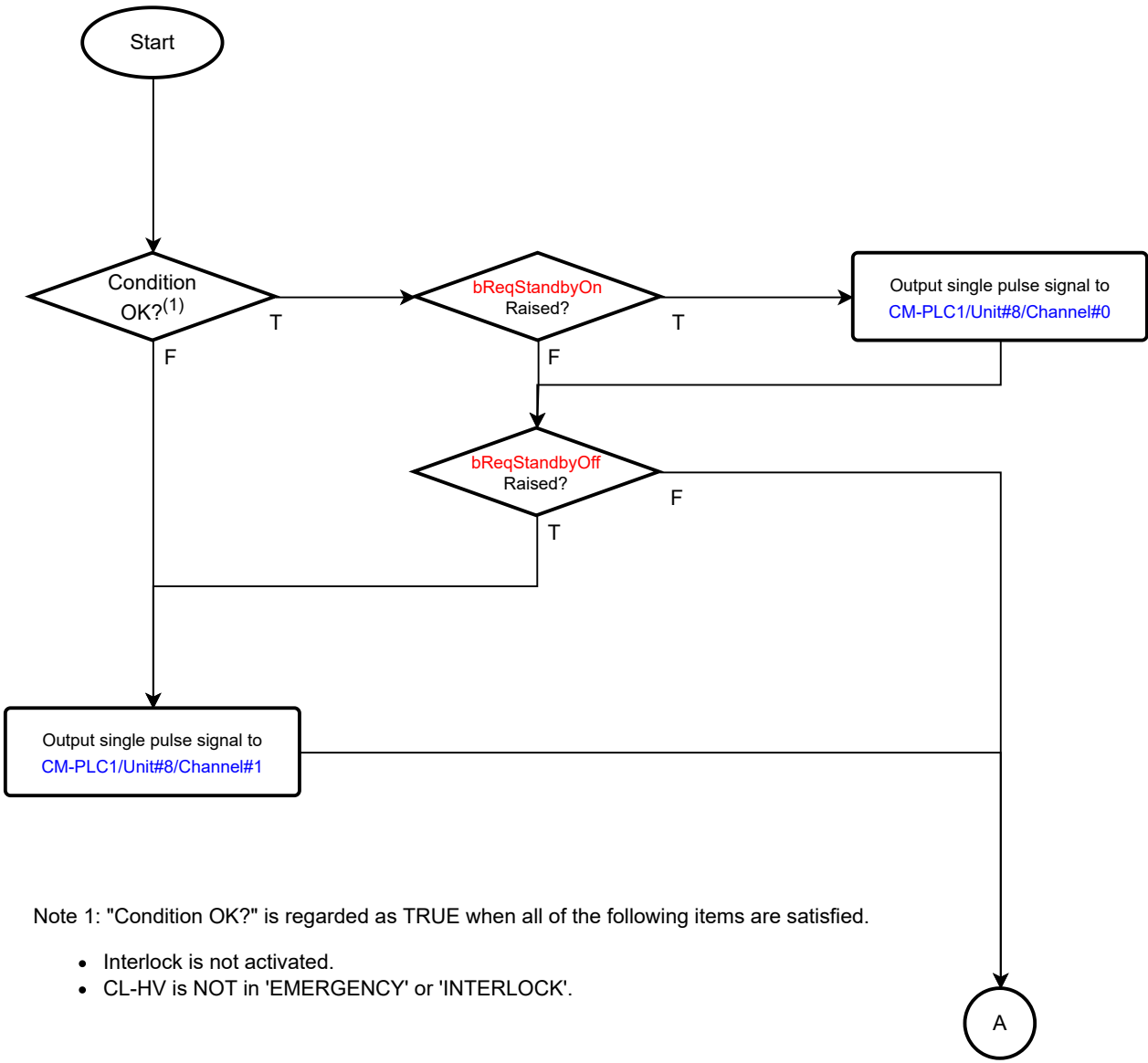
APPENDIX XII : PLC Internal Processing Flowchart

The graphical symbols in this document comply with ISO5807:1985/JIS X 0121:1986. However, complex conditions are described in the flowchart as a single branch that asks whether the condition matches (Condition OK?), and detailed conditions are described in the notes.

In addition, red letters indicate public variables in OPC UA, and blue letters indicate the unit number and channel number of the PLC's component. The notation "A: B.C" indicates that variable A, which is indicated on the flowchart, is member variable C of structure B.



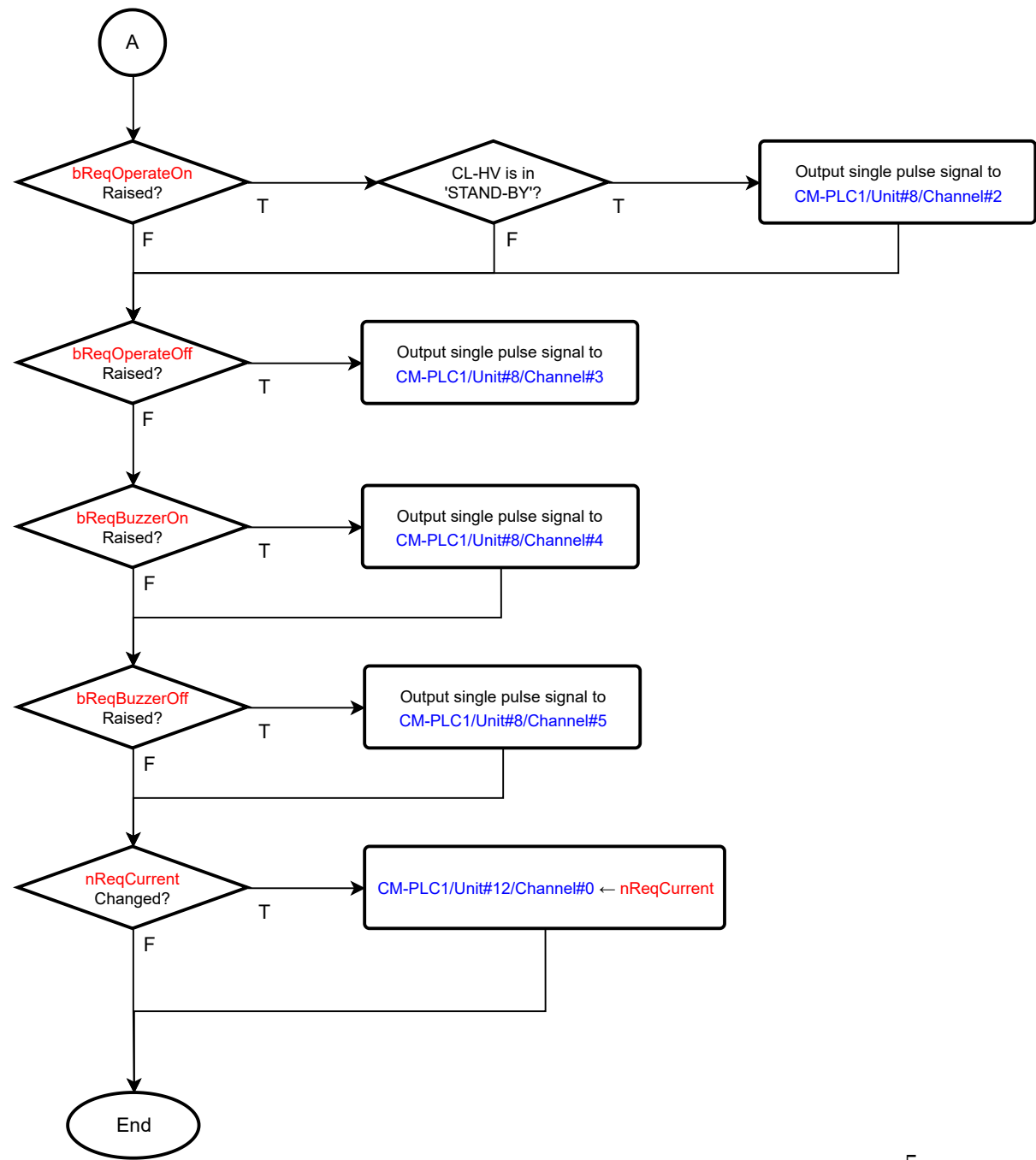




bReqStandbyOff: CL_HV_sCntl.bReqStandbyOff
bReqStandbyOn: CL_HV_sCntl.bReqStandbyOn

Note 1: "Condition OK?" is regarded as TRUE when all of the following items are satisfied.

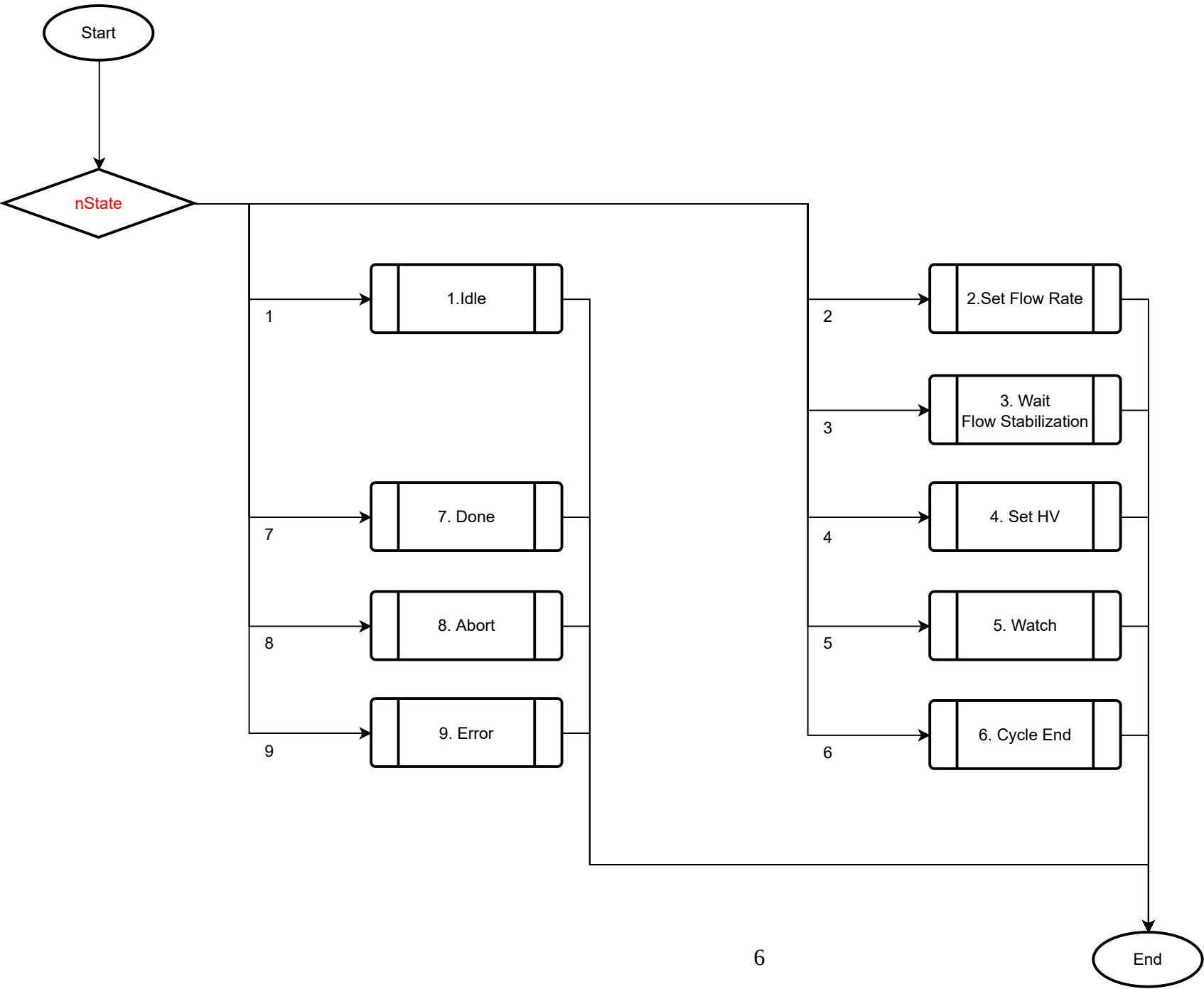
- Interlock is not activated.
- CL-HV is NOT in 'EMERGENCY' or 'INTERLOCK'.



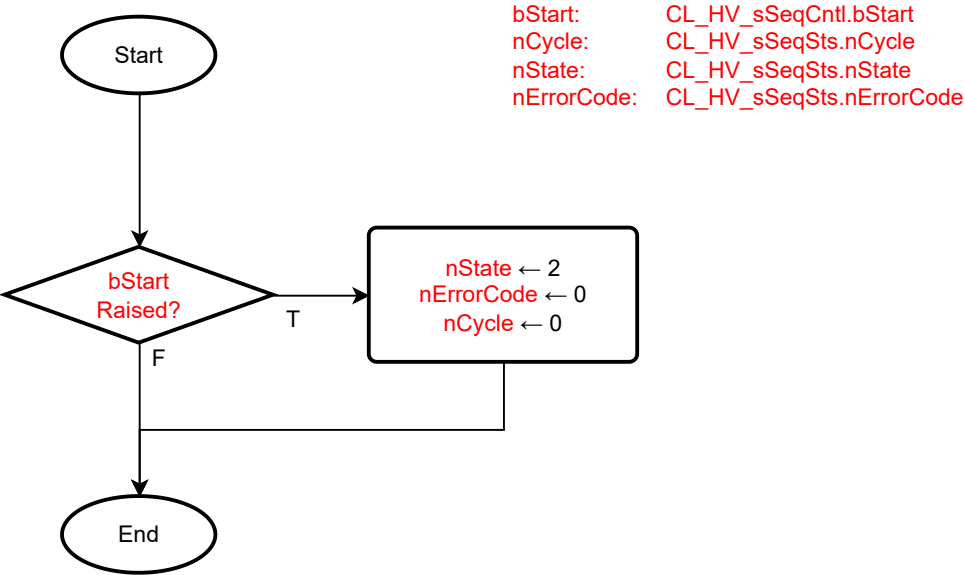
bReqOperateOff: CL_HV_sCntl.bReqOperateOff
bReqOperateOn: CL_HV_sCntl.bReqOperateOn
bReqBuzzerOff: CL_HV_sCntl.bReqBuzzerOff
bReqBuzzerOn: CL_HV_sCntl.bReqBuzzerOn
nReqCurrent: CL_HV_sCntl.nReqCurrent

■ CL-HV Auto Ramp-up Sequence Overview

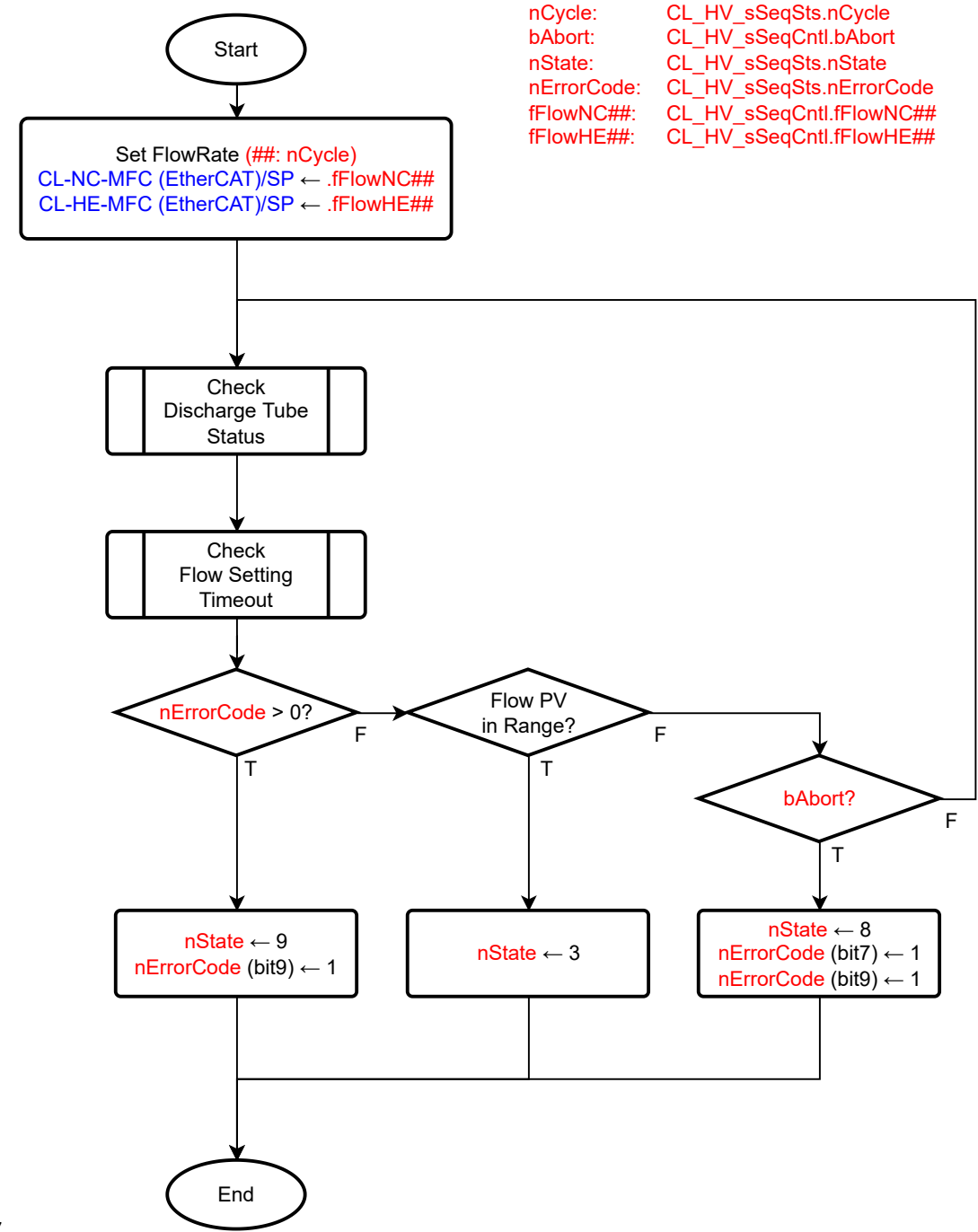
nState: CL_HV_sSeqSts.nState



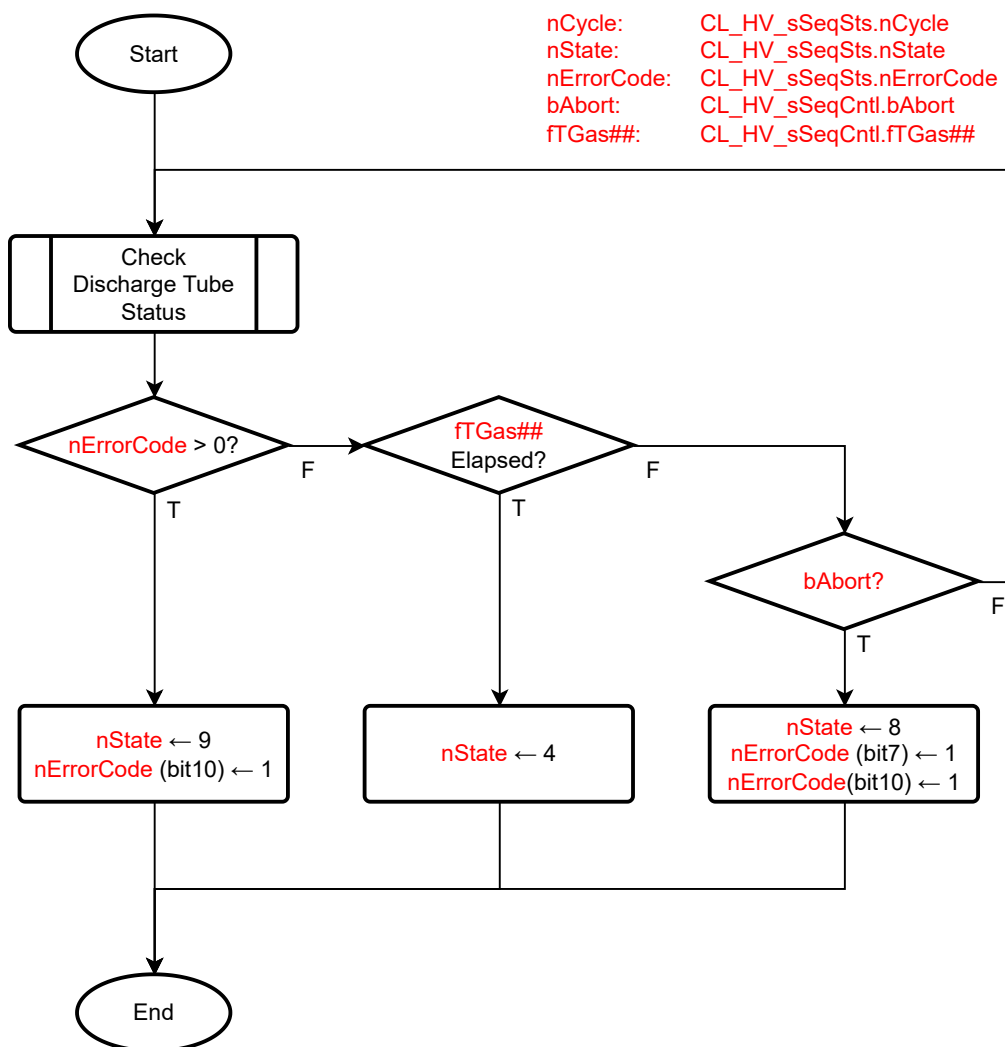
■ CL-HV Auto Ramp-up Sequence 1.Idle



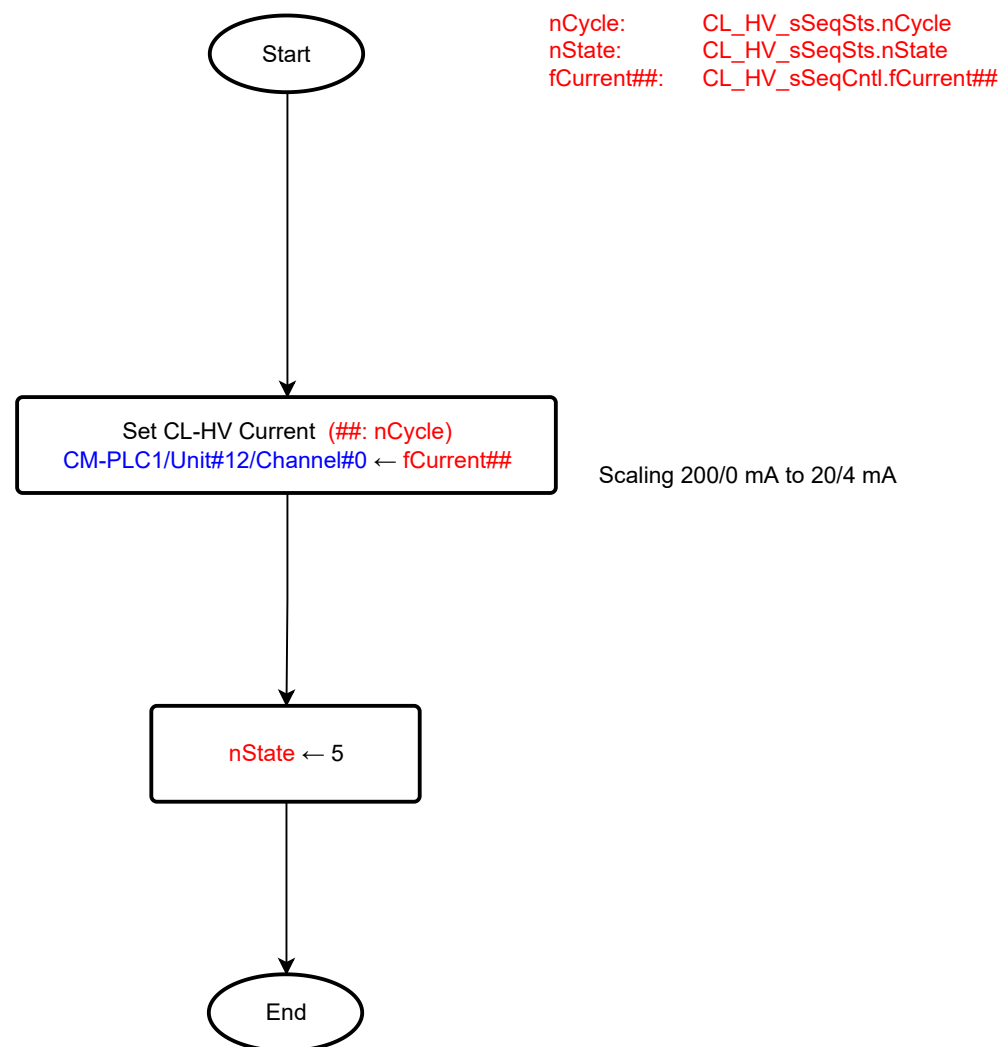
■ CL-HV Auto Ramp-up Sequence 2.Set Flow Rate



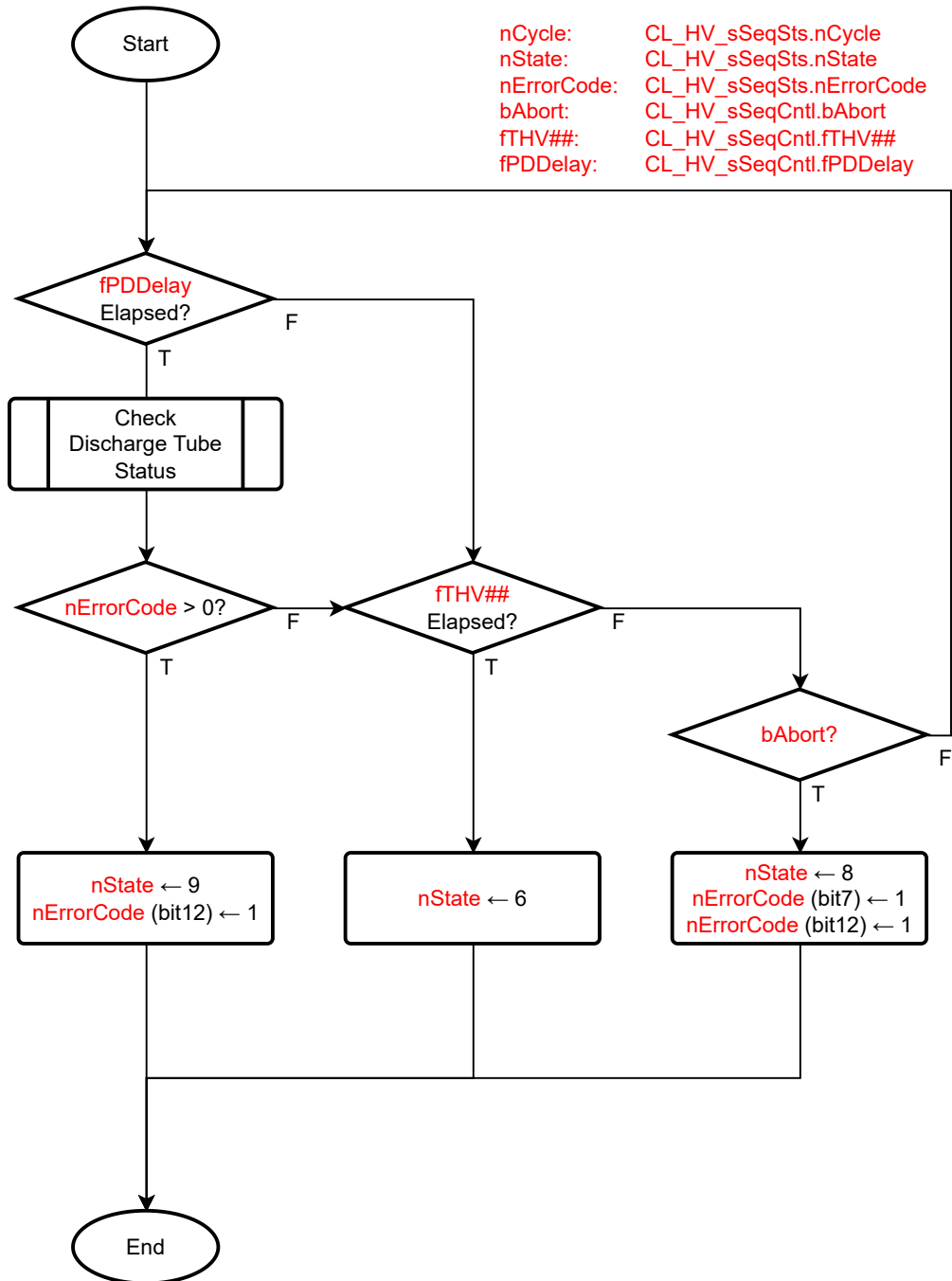
CL-HV Auto Ramp-up Sequence 3. Wait Flow Stabilization



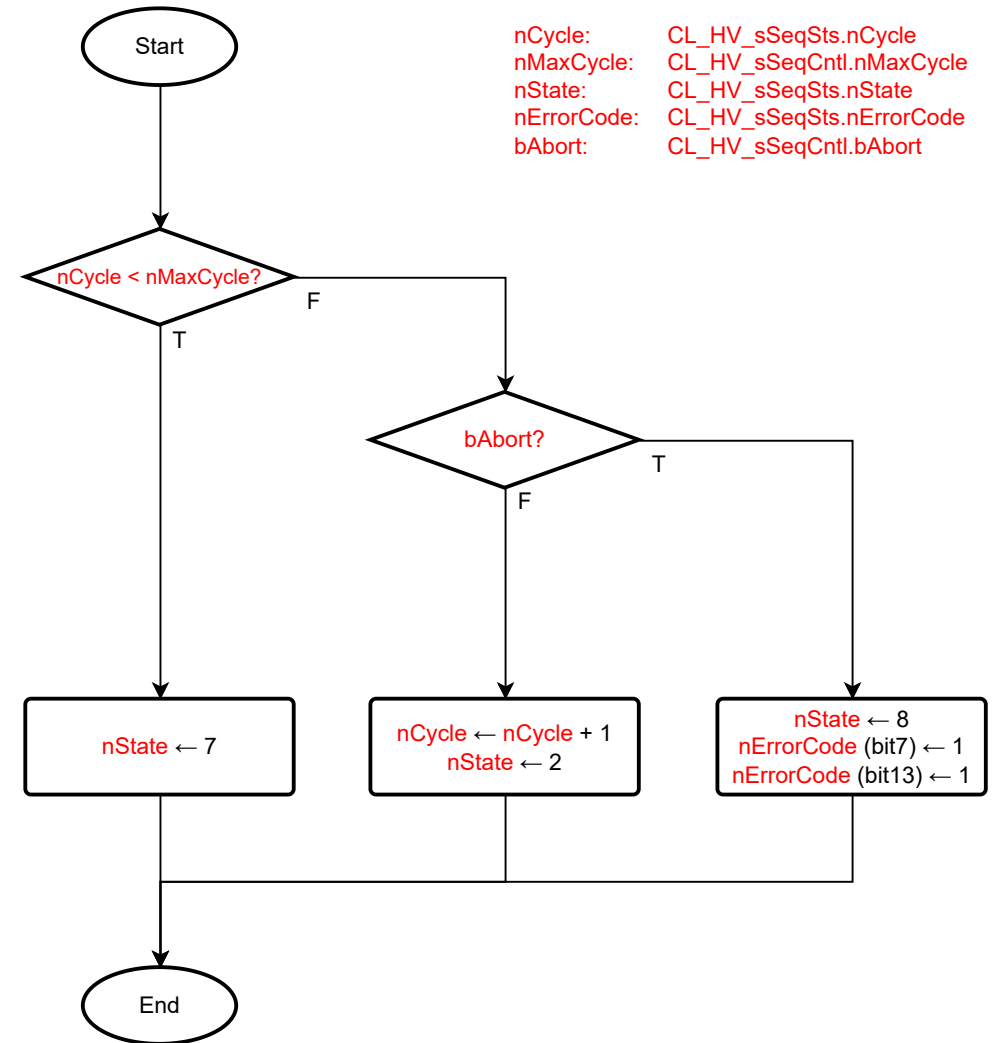
CL-HV Auto Ramp-up Sequence 4. Set HV Current



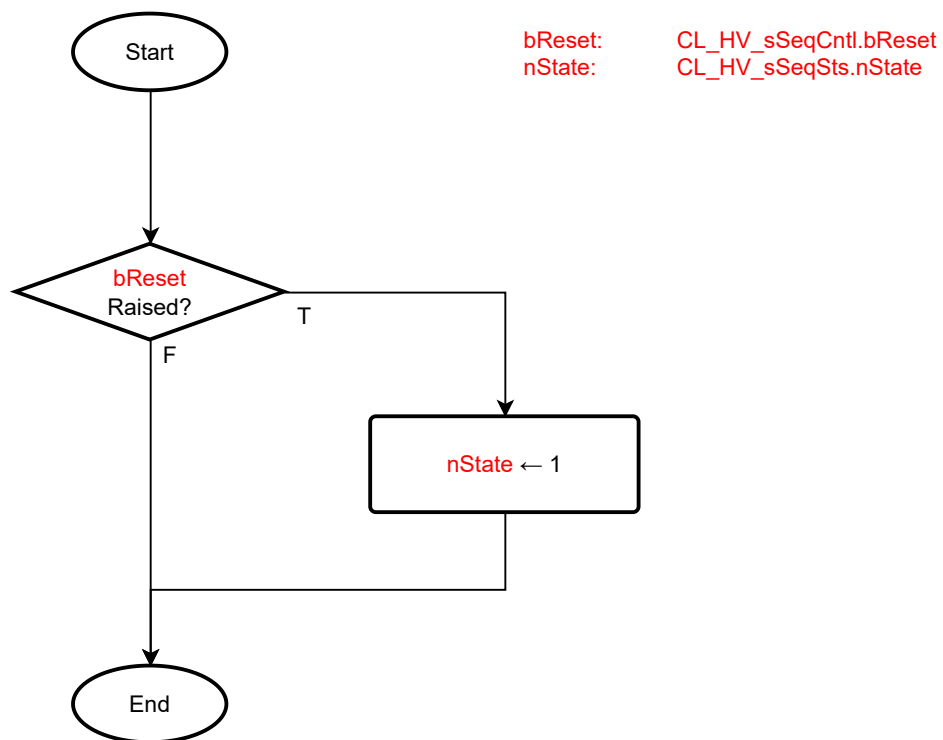
■ CL-HV Auto Ramp-up Sequence 5. Watch Unvalance



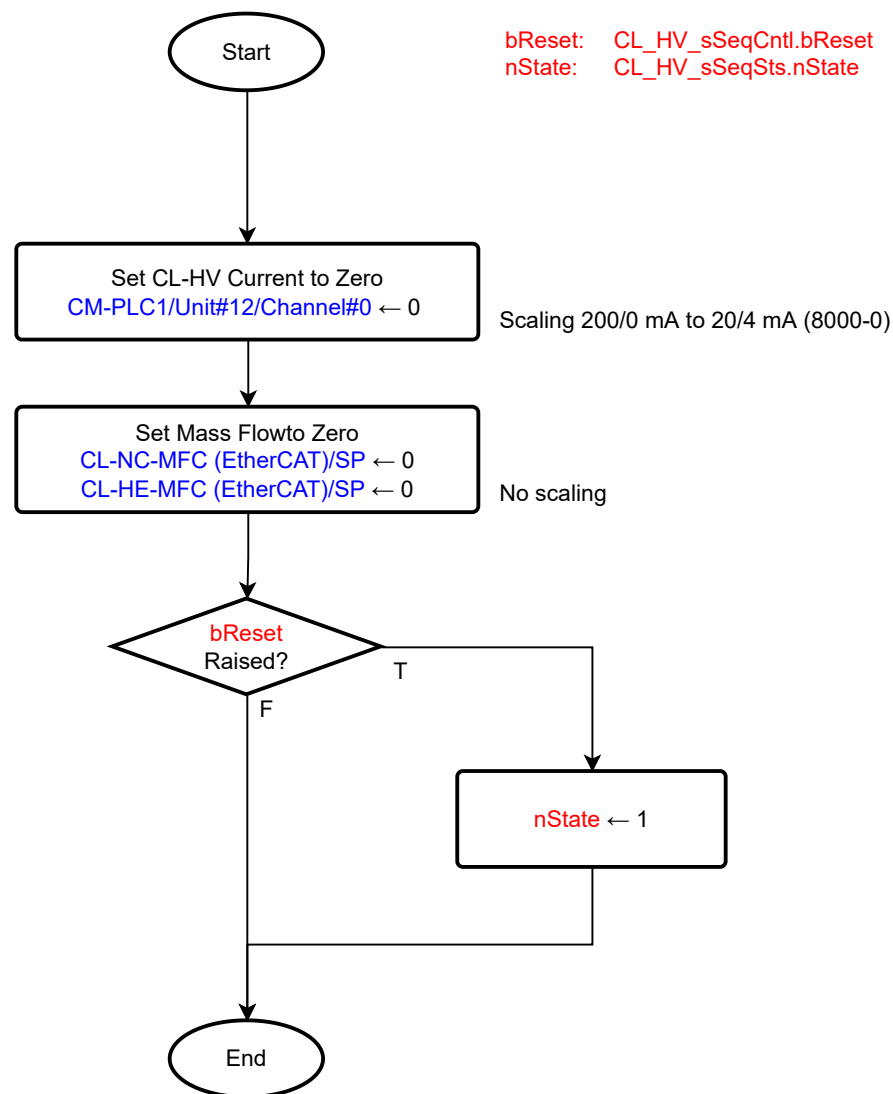
■ CL-HV Auto Ramp-up Sequence 6. End of Cycle



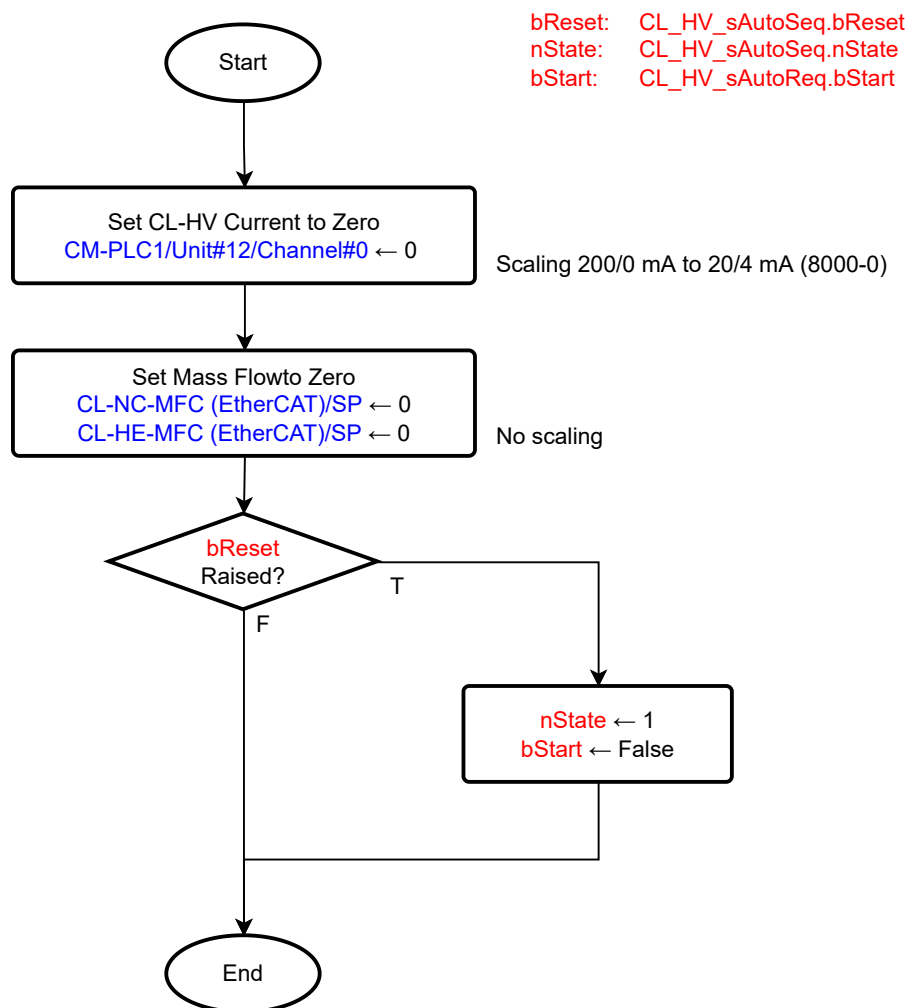
■ CL-HV Auto Ramp-up Sequence 7. Done



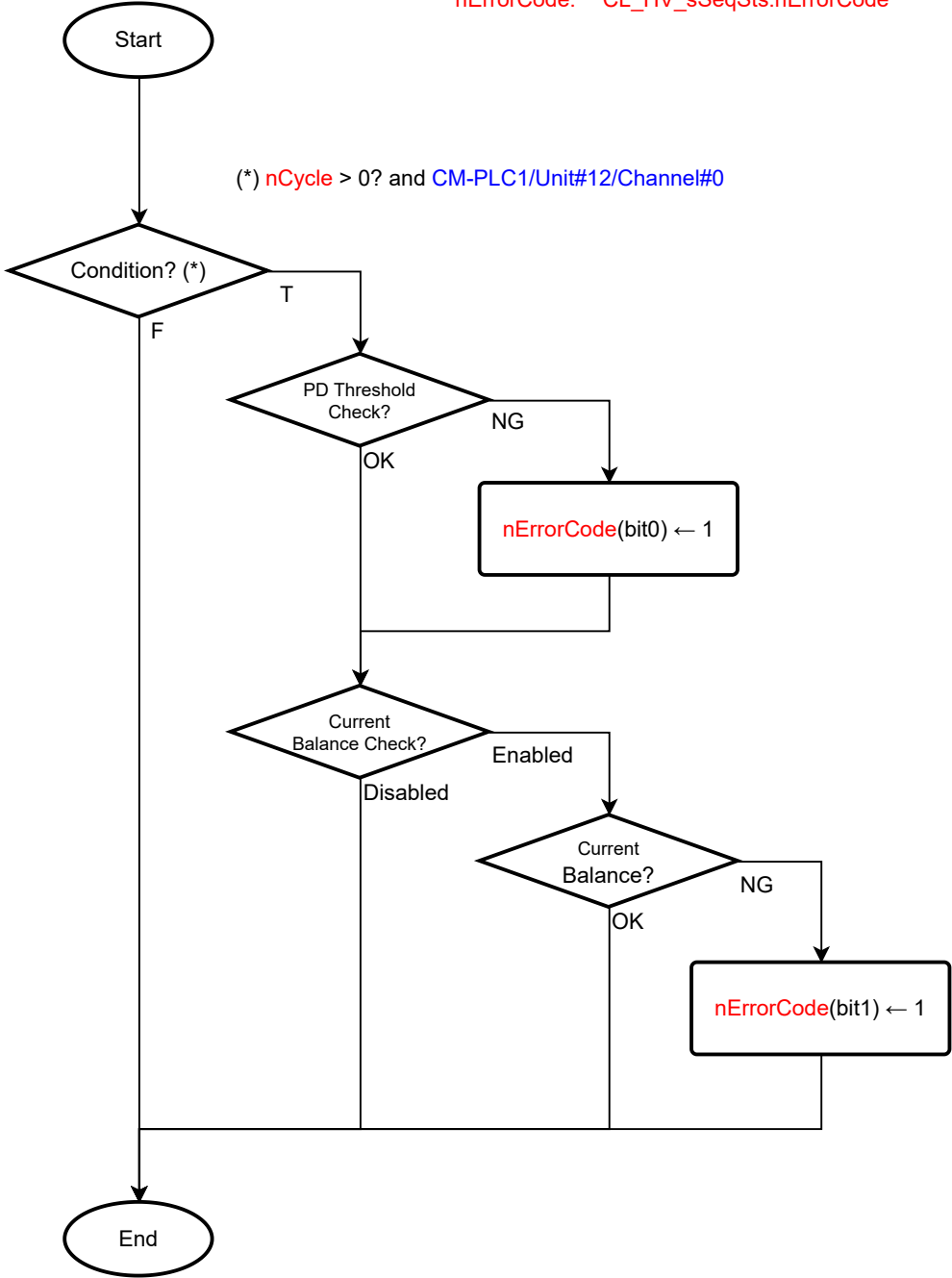
■ CL-HV Auto Ramp-up Sequence 8. Abort



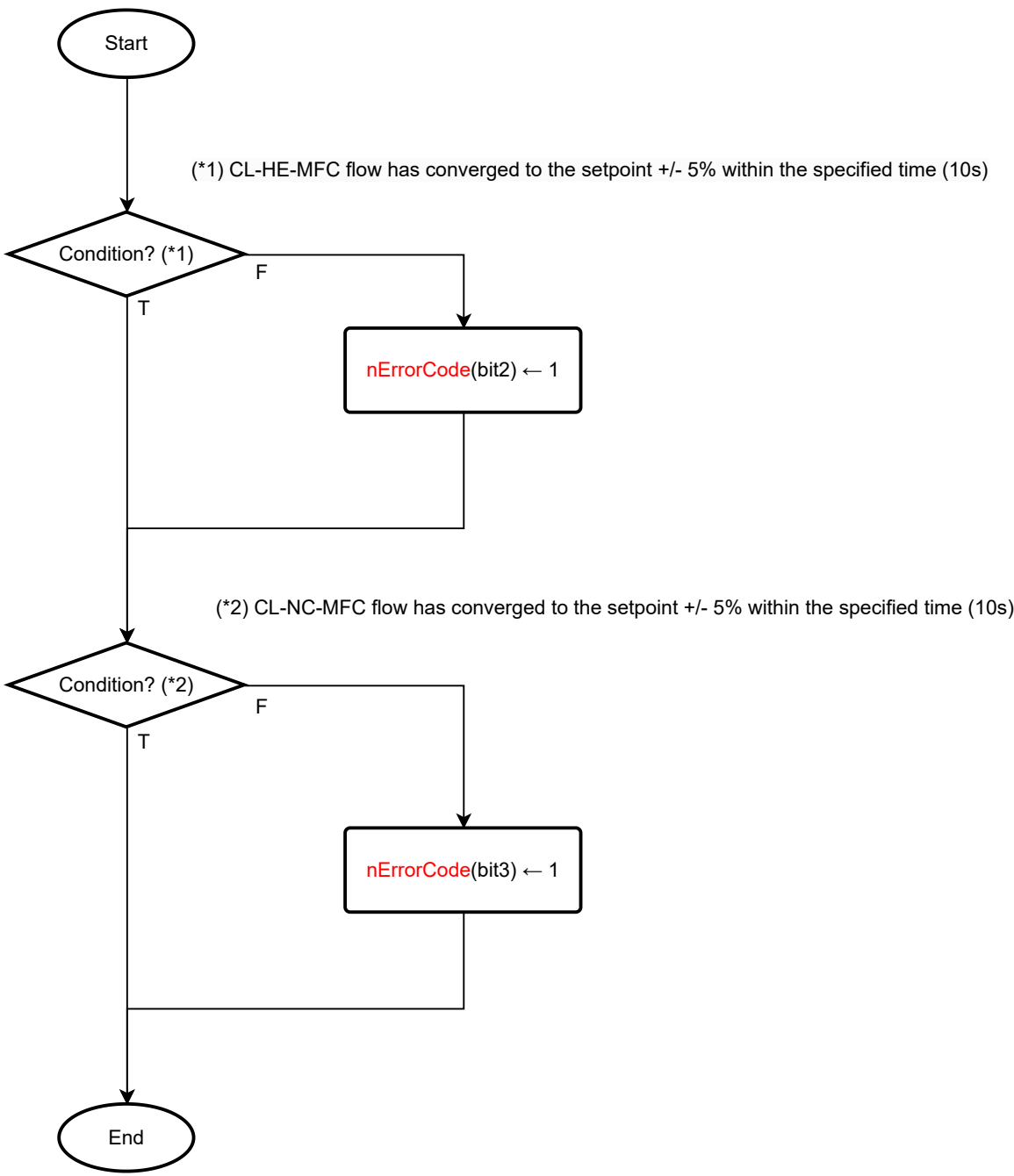
■ CL-HV Auto Ramp-up Sequence 9. Error

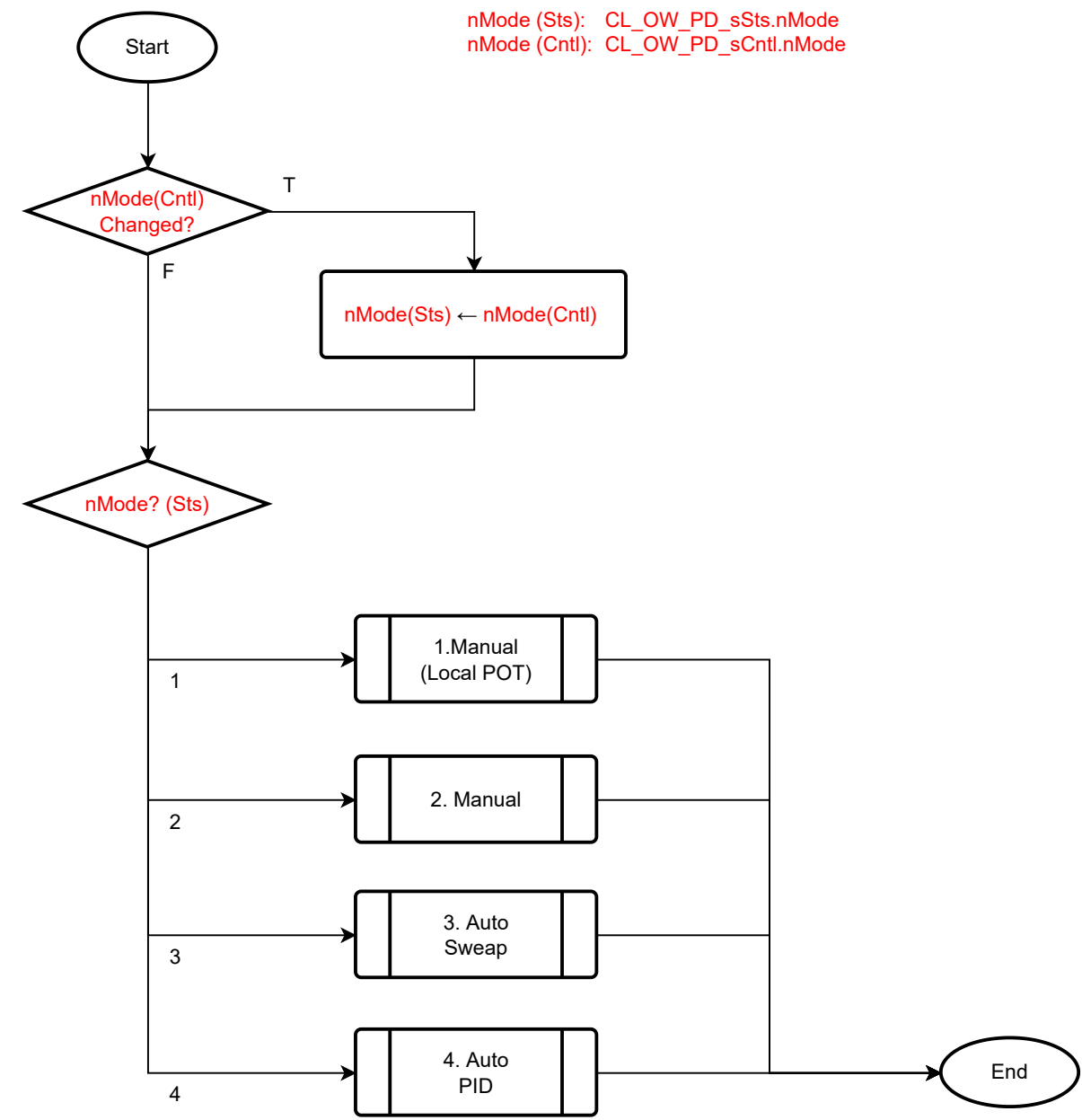


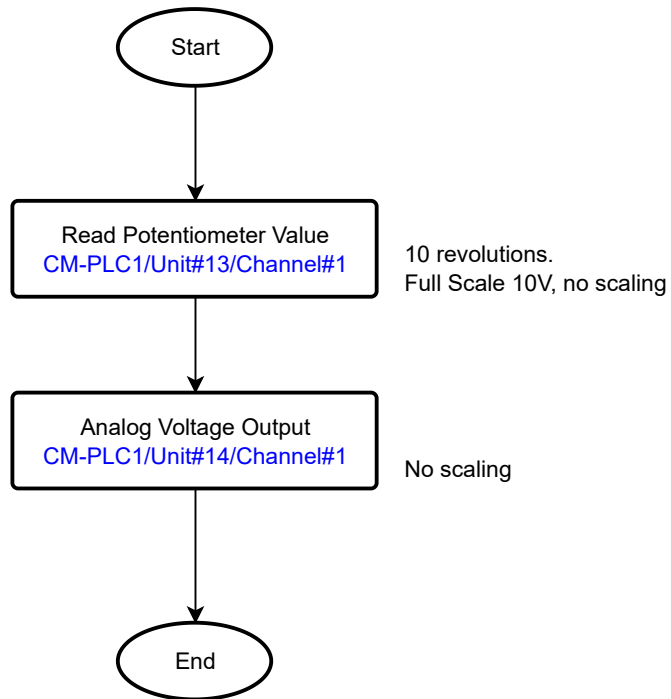
nState: CL_HV_sSeqSts.nState
nErrorCode: CL_HV_sSeqSts.nErrorCode



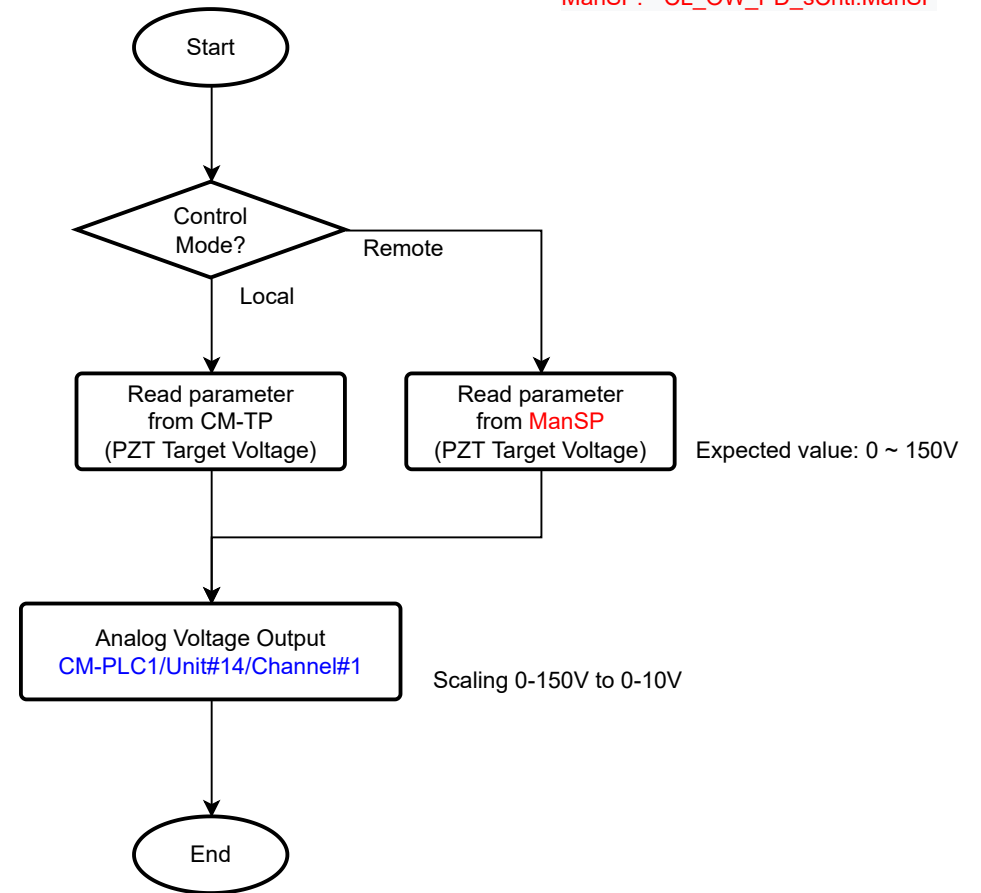
nErrorCode: CL_HV_sSeqSts.nErrorCode

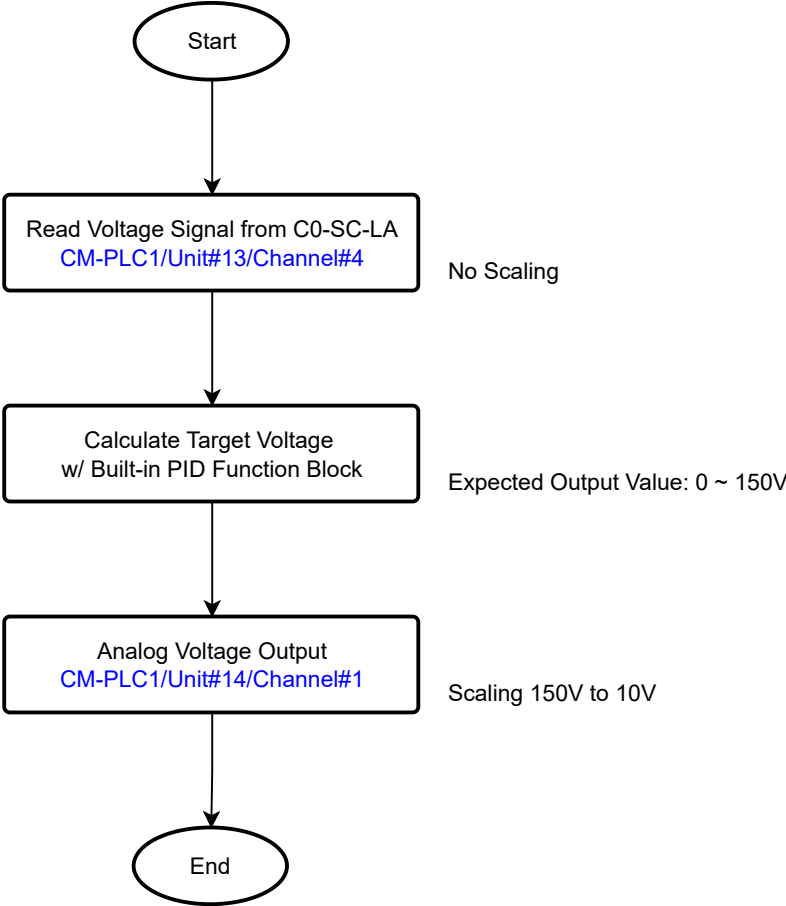
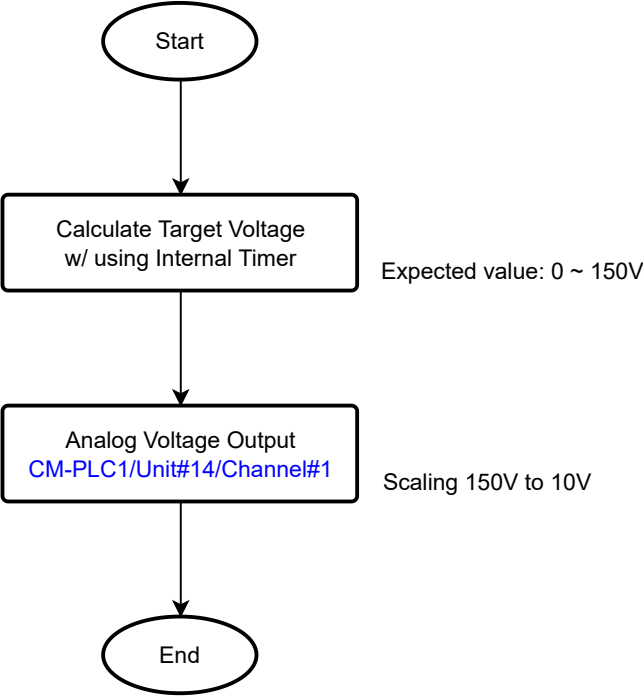


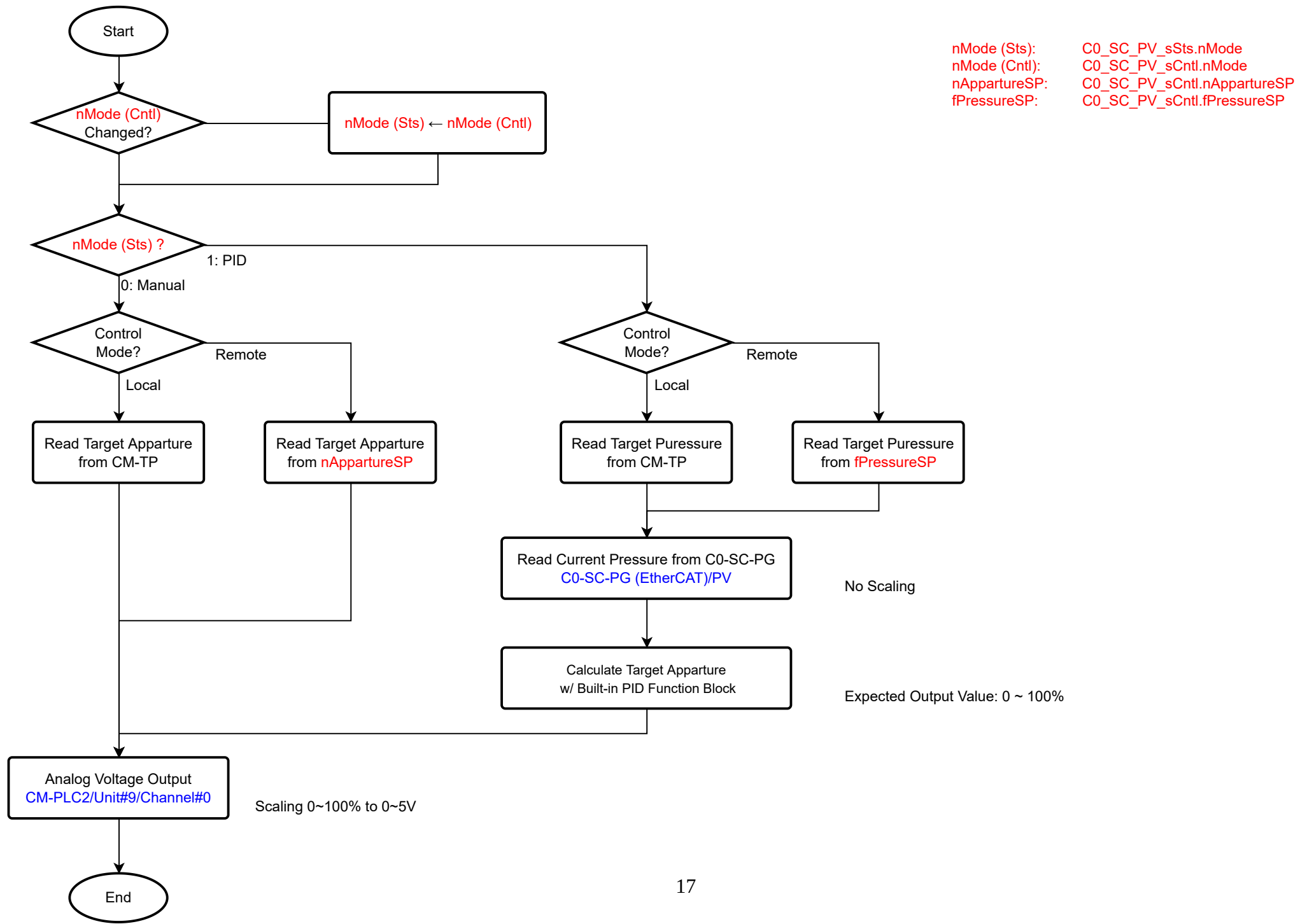


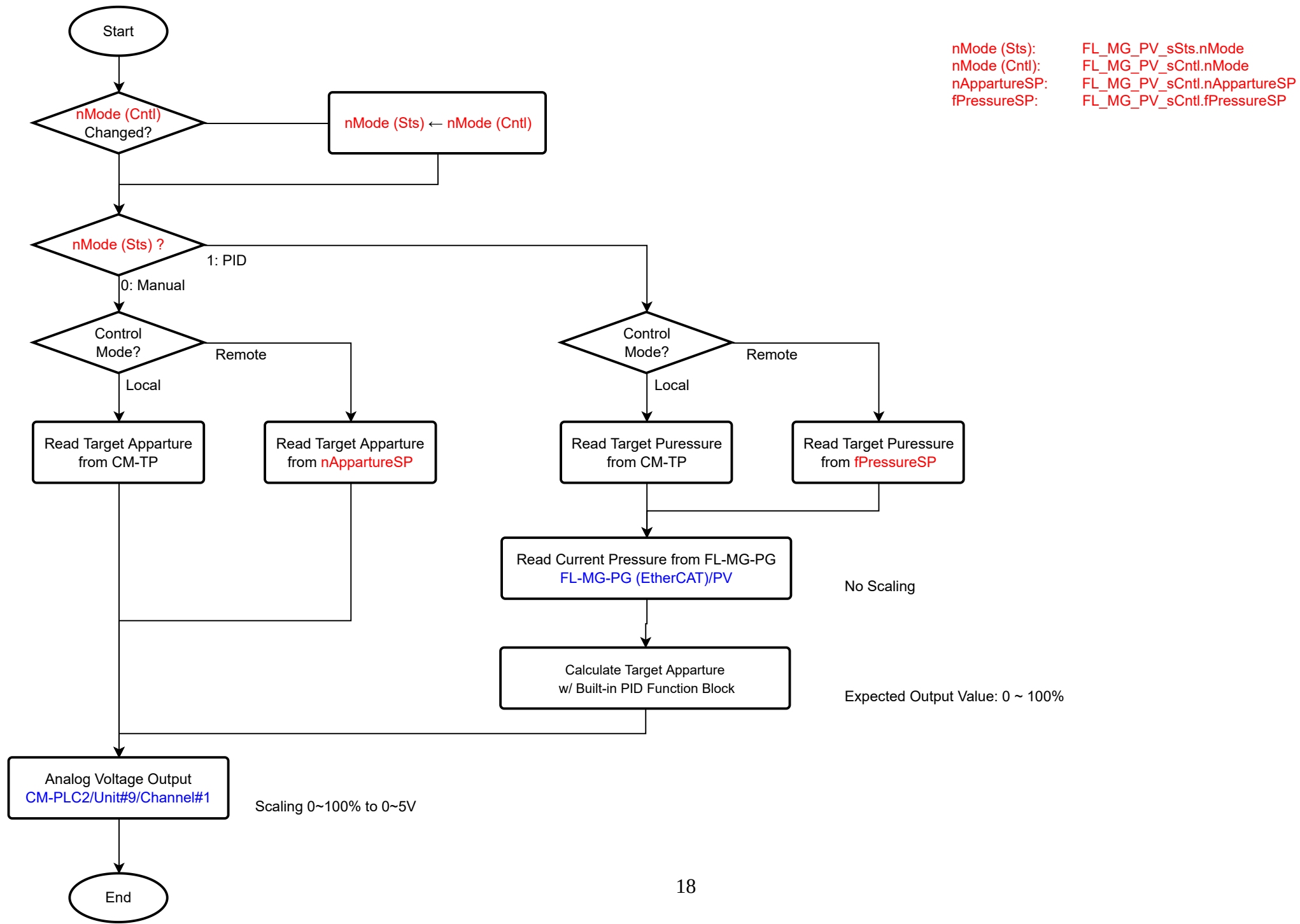


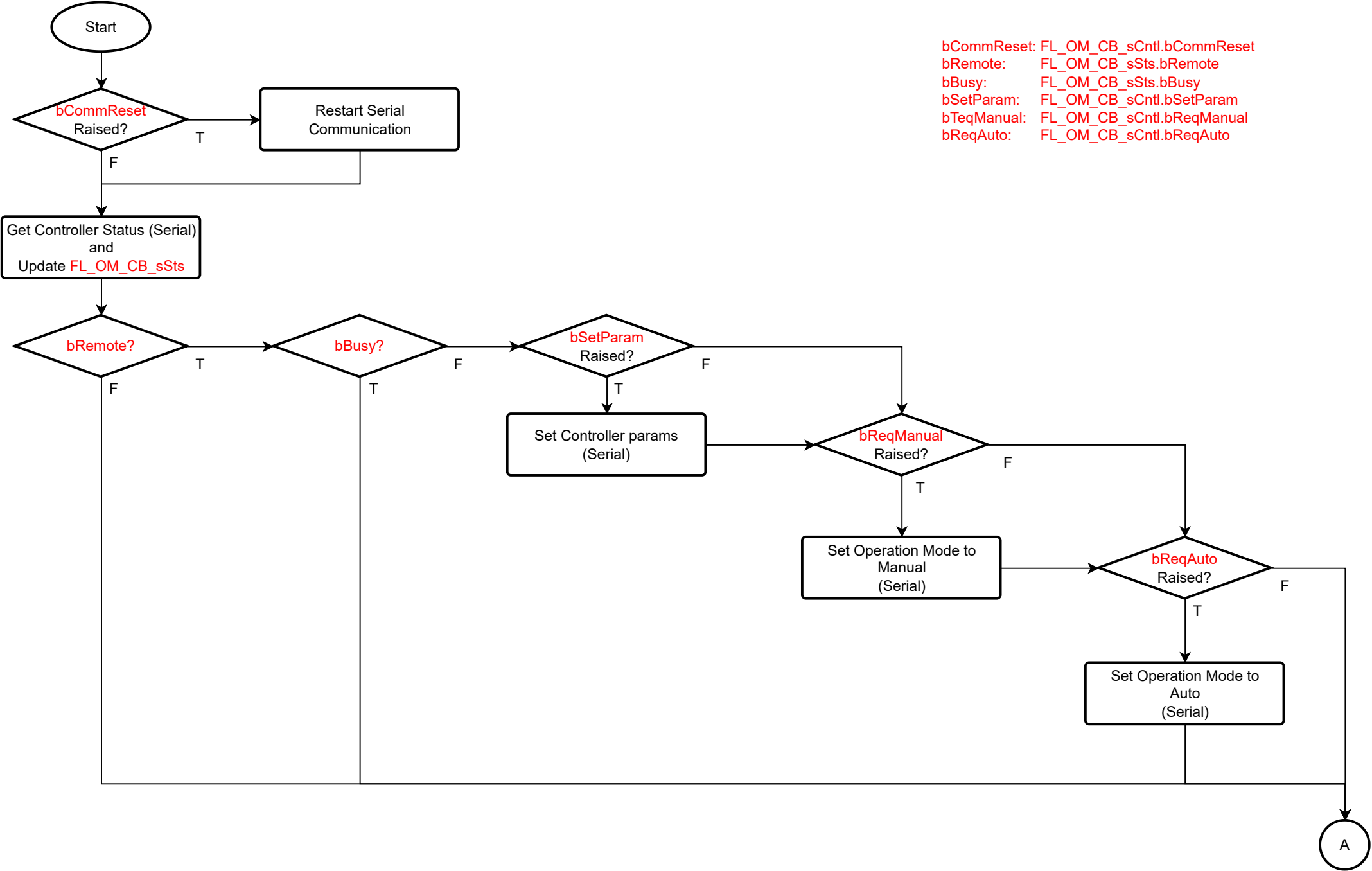
ManSP: CL_OW_PD_sCntl.ManSP

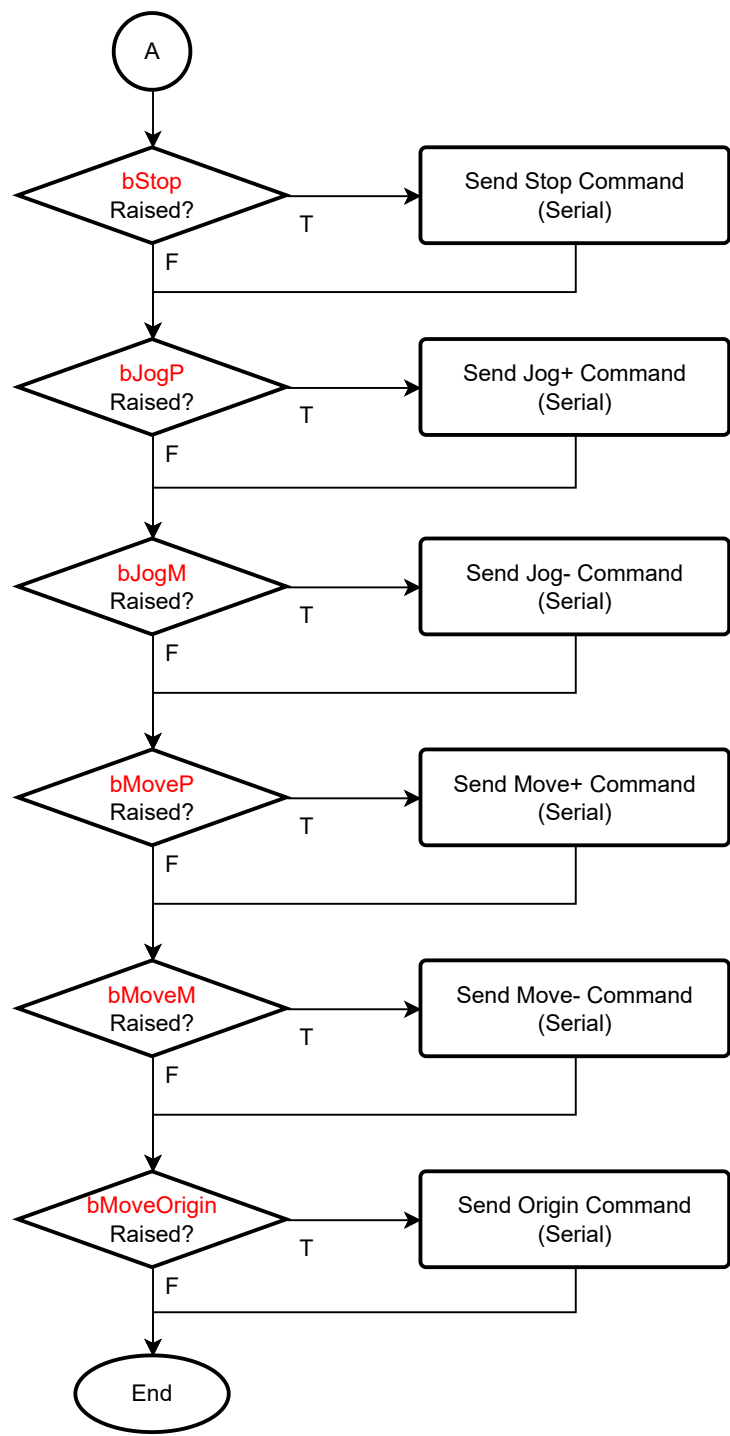






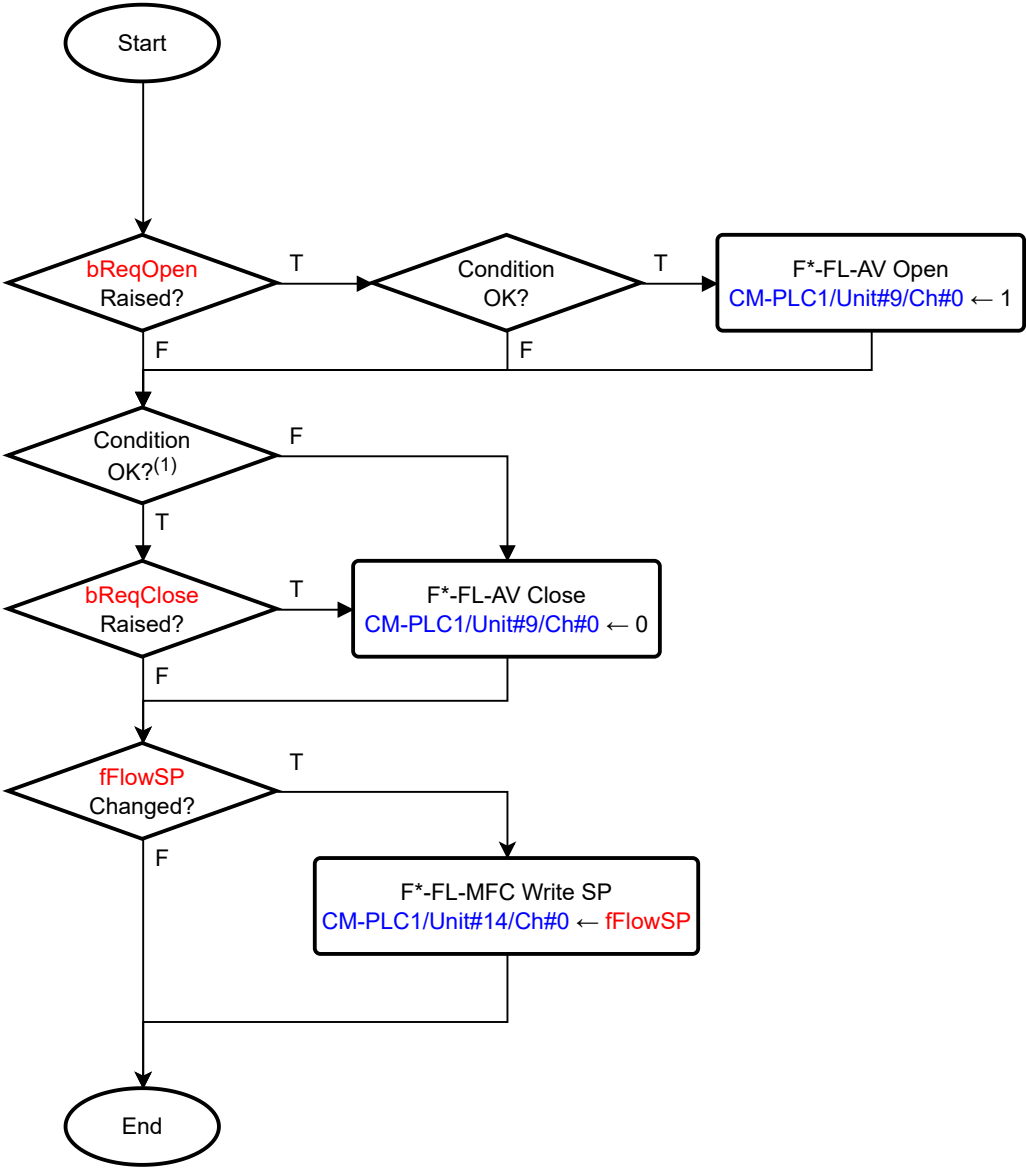






bStop: FL_OM_CB_sCntl.bStop
bJogP: FL_OM_CB_sCntl.bJogP
bJogM: FL_OM_CB_sCntl.bJogM
bMoveP: FL_OM_CB_sCntl.bMoveP
bMoveM: FL_OM_CB_sCntl.bMoveM
bMoveOrigin: FL_OM_CB_sCntl.bMoveOrigin

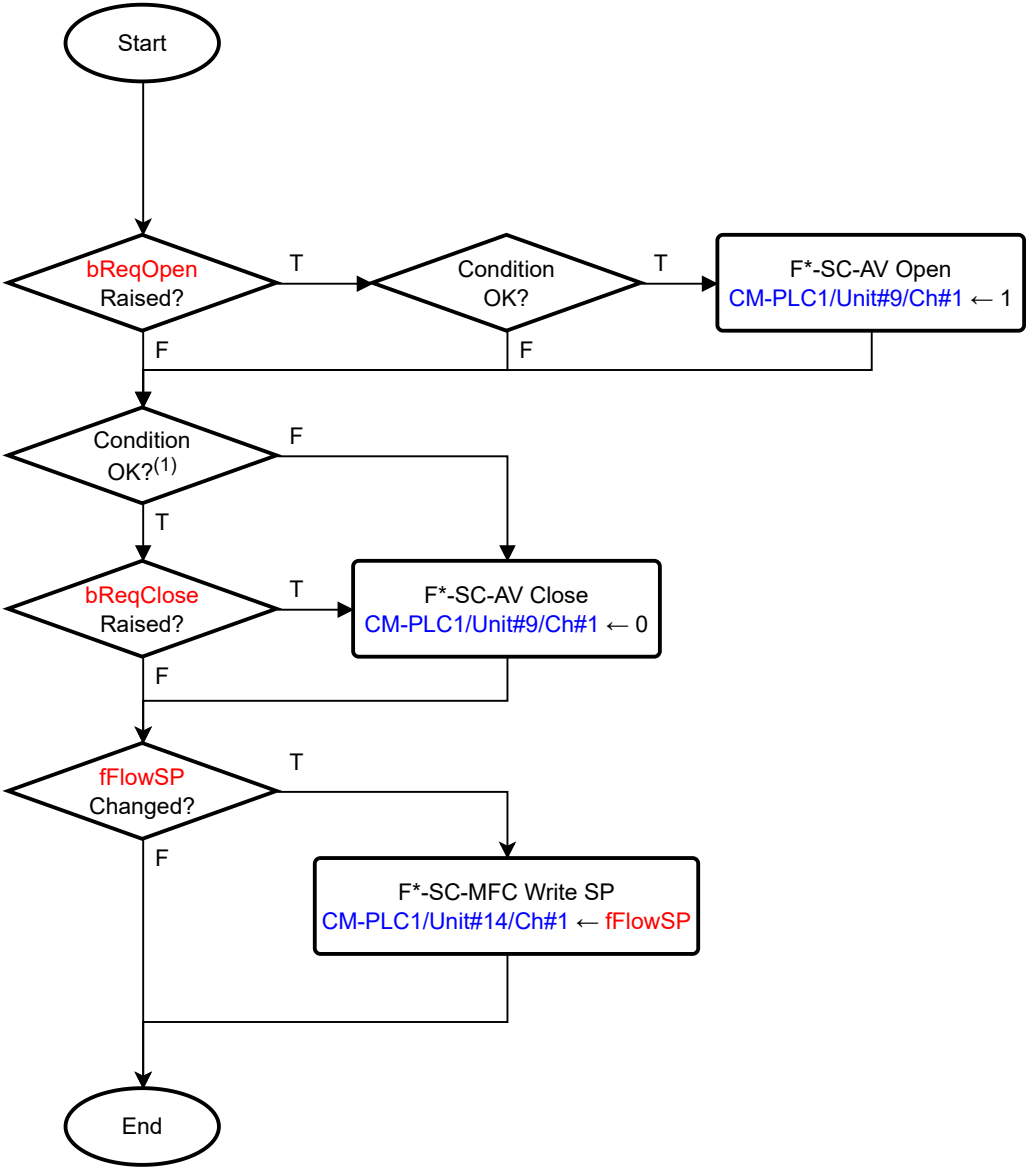
bReqOpen: F*_FL_AV_sCntl.bReqOpen
bReqClose: F*_FL_AV_sCntl.bReqClose
fFlowSP: F*_FL_MFC_sCntl.fFlowSP



Note 1: "Condition OK?" is regarded as TRUE when all of the following items are satisfied.

- Interlock is not activated.

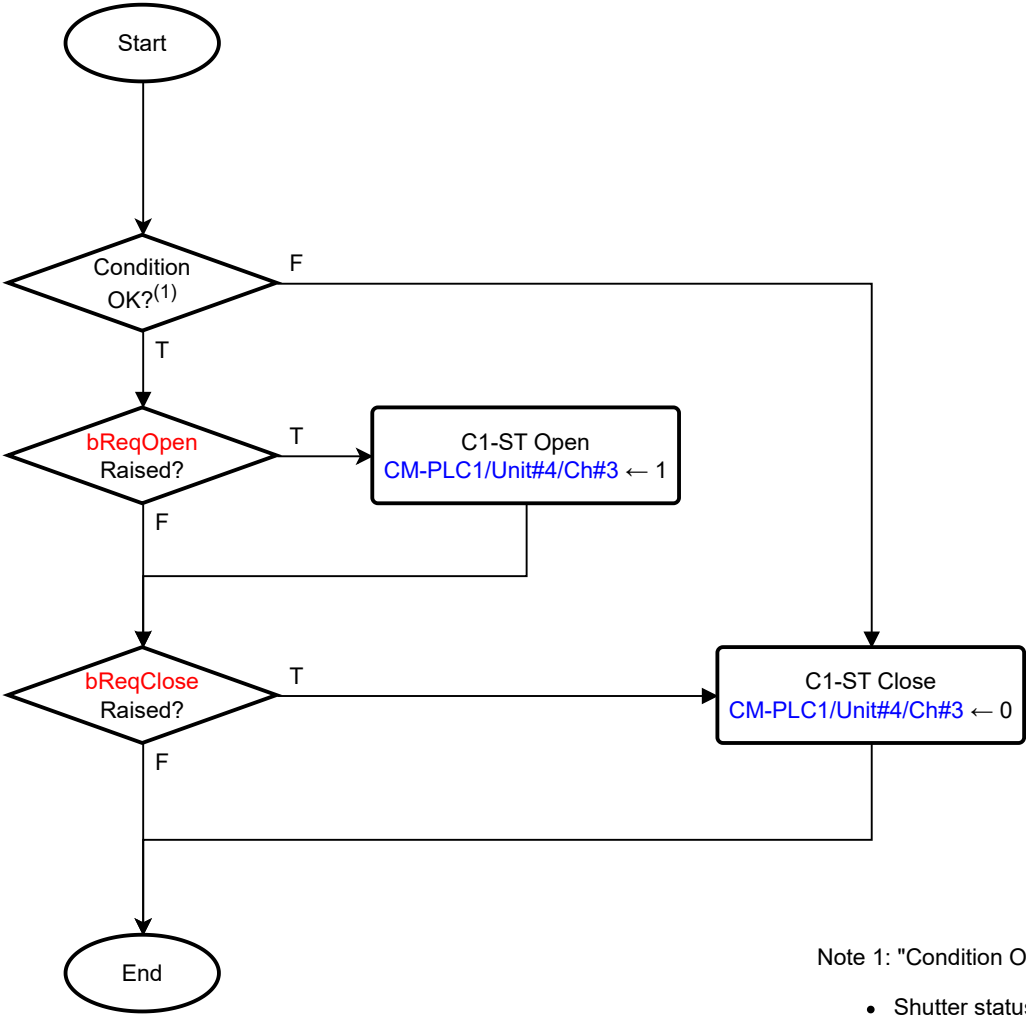
bReqOpen: F*_SC_AV_sCntl.bReqOpen
bReqClose: F*_SC_AV_sCntl.bReqClose
fFlowSP: F*_SC_MFC_sCntl.fFlowSP



Note 1: "Condition OK?" is regarded as TRUE when all of the following items are satisfied.

- Interlock is not activated.

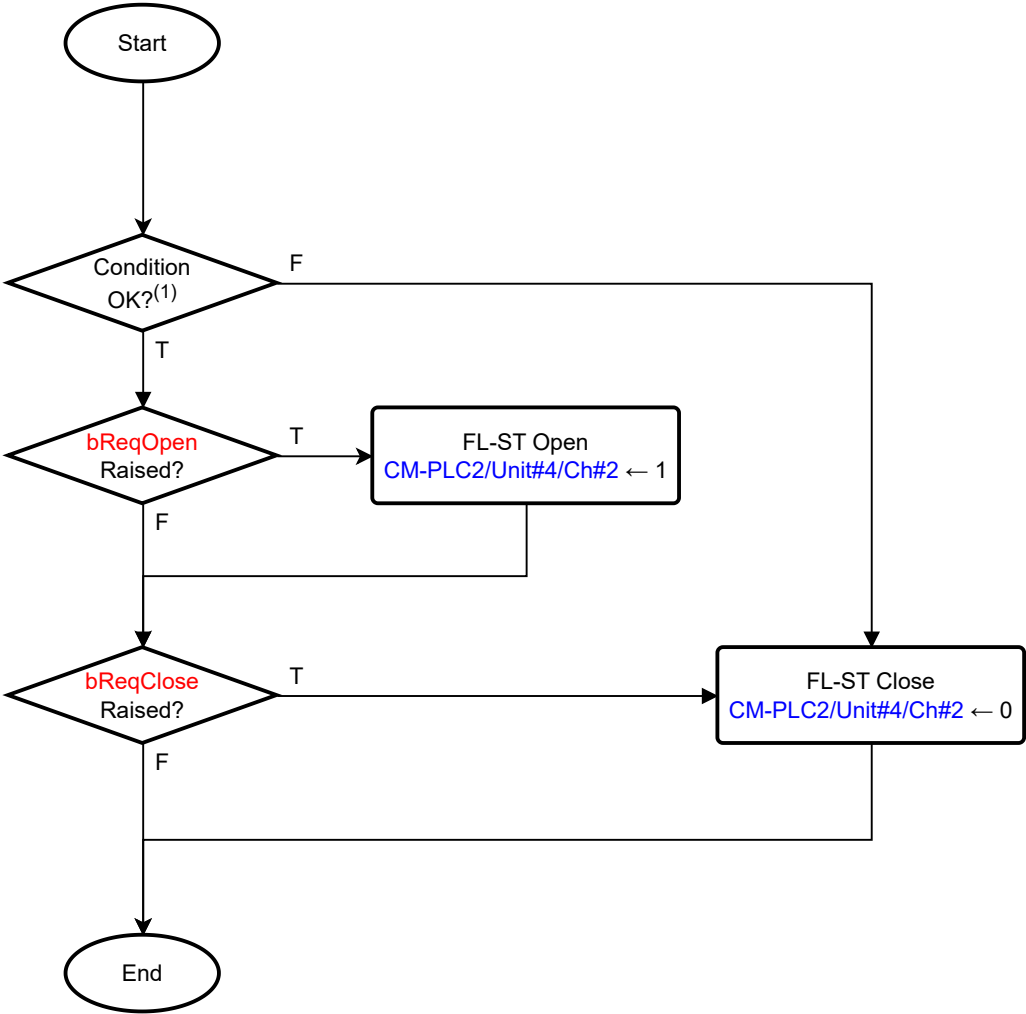
bReqOpen: C1_ST_sCntl.bReqOpen
bReqClose: C1_ST_sCntl.bReqClose



Note 1: "Condition OK?" is regarded as TRUE when all of the following items are satisfied.

- Shutter status is normal (Limit switches and control request states are consistent.)
- Interlock is not activated.
- C1-CV-SW or CM-PB-SW3 is activated.
- Optical path to FL or C1-PM-M is cleared.
 - C1-PM-M position is Inserted or Removed.
 - C1-VL-M2 position is Removed
- CH₃OH supply to FIR laser tube is normal (this item evaluates only if C1-PM-M is in Removed position)

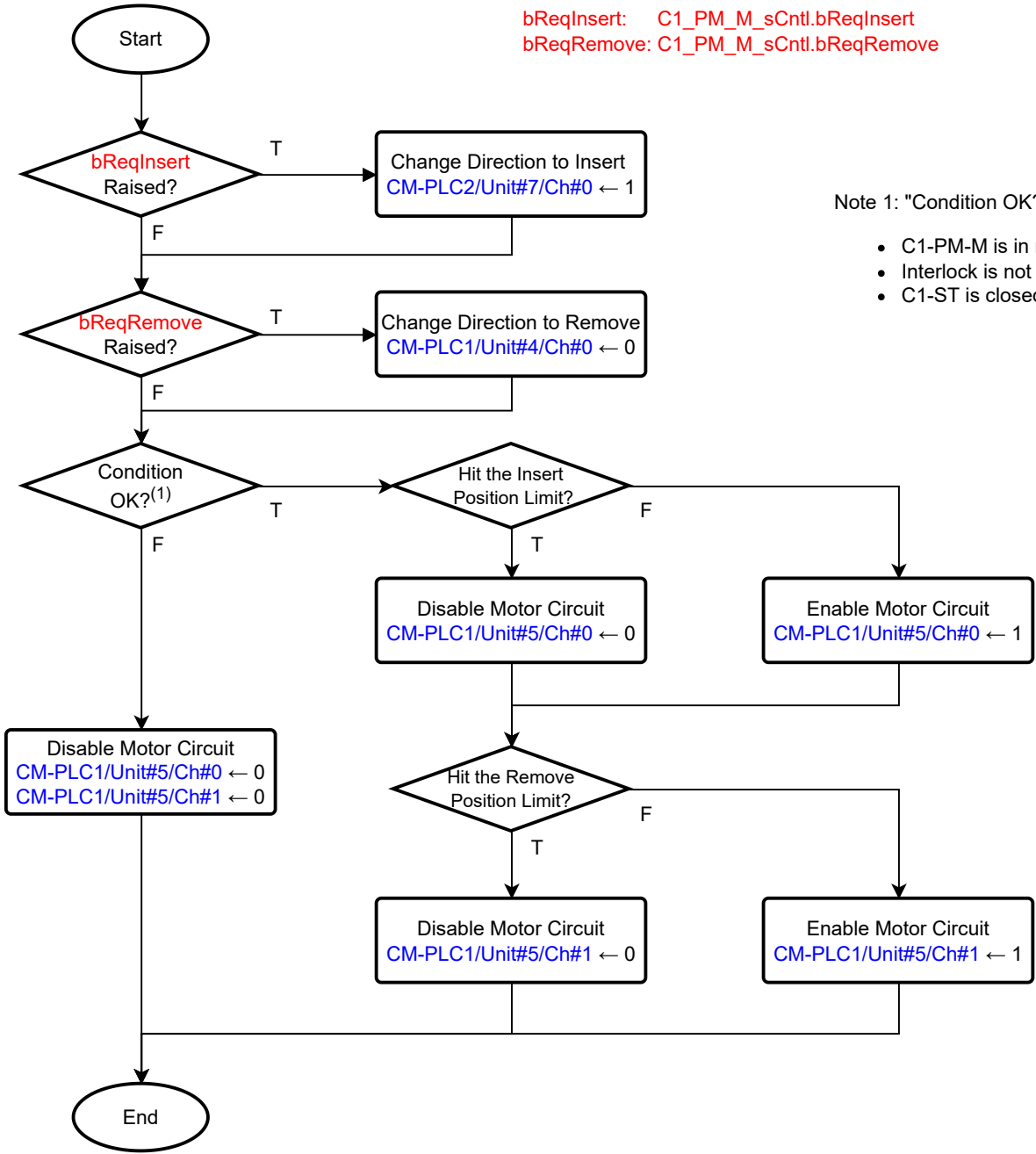
bReqOpen: FL_ST_sCntl.bReqOpen
bReqClose: FL_ST_sCntl.bReqClose



Note 1: "Condition OK?" is regarded as TRUE when all of the following items are satisfied.

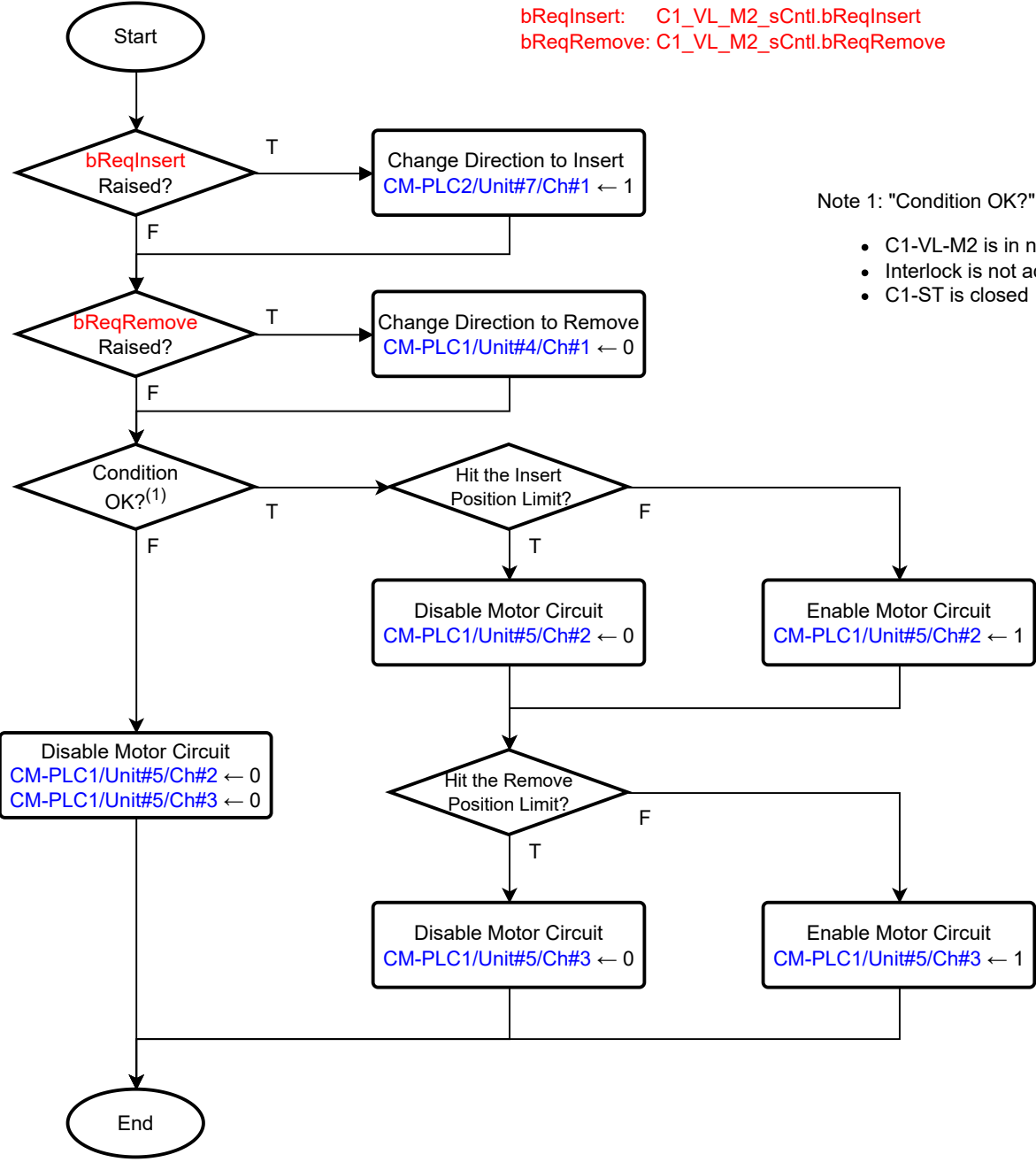
- Shutter status is normal (Limit switches and control request states are consistent.)
- Interlock is not activated.
- CM-EI(External Interlock signal from Monitoring PLC) is not activated.

bReqInsert: C1_PM_M_sCntl.bReqInsert
bReqRemove: C1_PM_M_sCntl.bReqRemove



Note 1: "Condition OK?" is regarded as TRUE when all of the following items are satisfied.

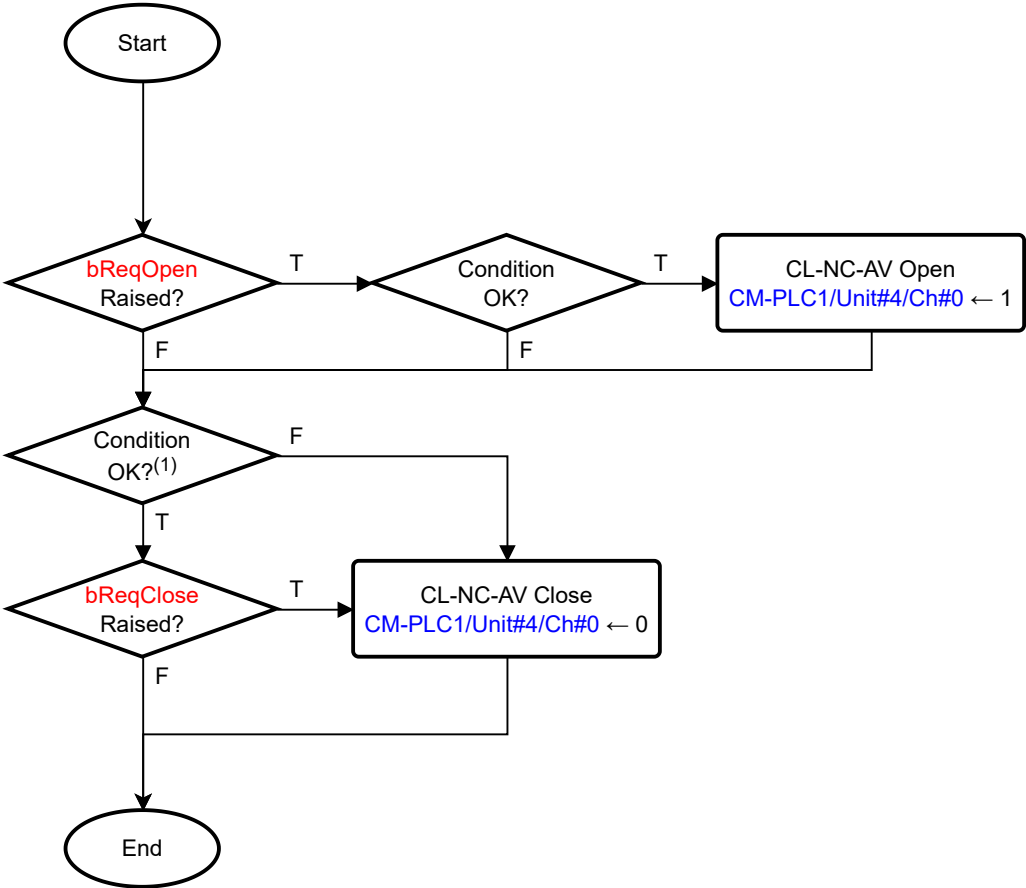
- C1-PM-M is in normal operation (Limit switches and control request states are consistent.)
- Interlock is not activated.
- C1-ST is closed



Note 1: "Condition OK?" is regarded as TRUE when all of the following items are satisfied.

- C1-VL-M2 is in normal operation (Limit switches and control request states are consistent.)
- Interlock is not activated.
- C1-ST is closed

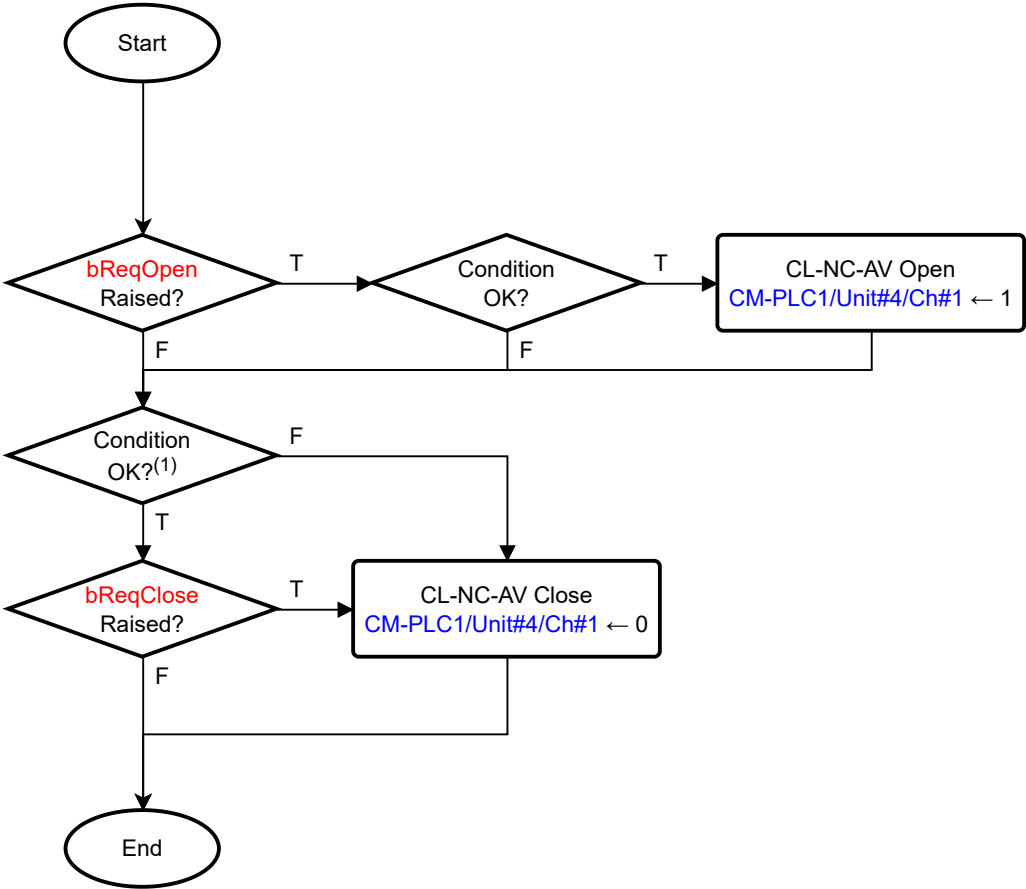
bReqOpen: CL_NC_AV_sCntl.bReqOpen
bReqClose: CL_NC_AV_sCntl.bReqClose



Note 1: "Condition OK?" is regarded as TRUE when all of the following items are satisfied.

- CL-MG-VP is in normal operation
- Interlock is not activated.

bReqOpen: CL_HE_AV_sCntl.bReqOpen
bReqClose: CL_HE_AV_sCntl.bReqClose

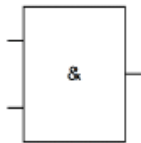
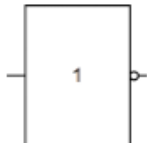
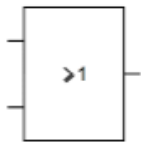
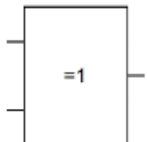


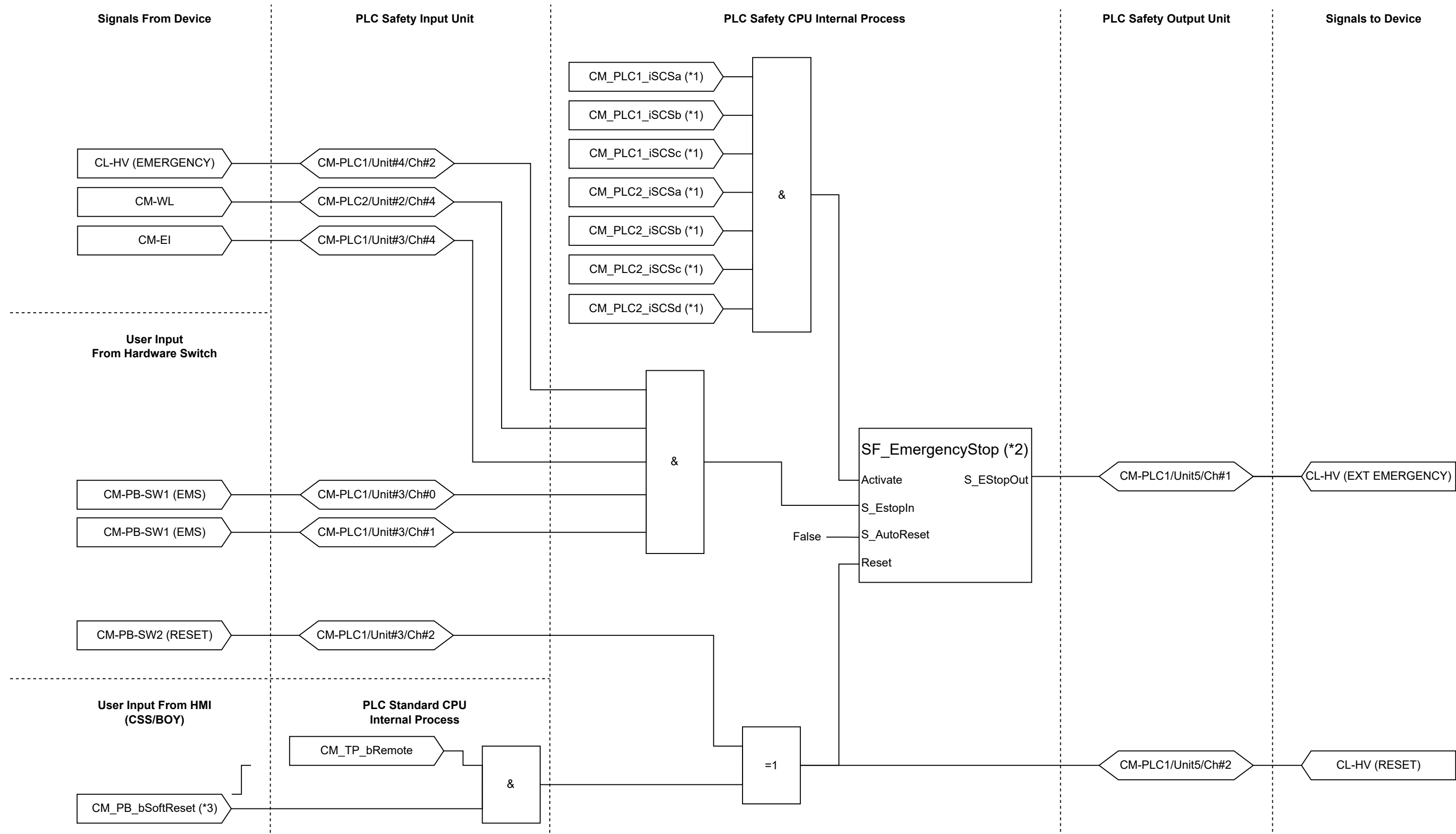
Note 1: "Condition OK?" is regarded as TRUE when all of the following items are satisfied.

- CL-MG-VP is in normal operation
- FL-MG-VP is in normal operation
- Interlock is not activated.

APPENDIX XIII : Interlock Condition Statement

Logic circuit symbols comply with IEC60617/JIS C0617. Unless otherwise noted, signals in the circuit are 1 or High when normal/valid and 0/Low when abnormal/invalid.

Logic	MIL	IEC/JIS	Logic	MIL	IEC/JIS
AND			NOT		
OR			XOR		



(*1) Internal variable of safety input/output unit communication status
(*2) This is a safety CPU integrated safety function block.
The description of this functional block is on pages 4-23 to 26 of document number 931-E1-05 released by OMRON.
(*3) Enabled when the rising edge of the signal is detected.

APPENDIX XIV : I/O Signal List

EtherCAT Device Configuration

Gr#	Name	Module#	Module Name	Function
0	CM-PLC1	0	NX102-9000	PLC CPU/General; EtherCAT Master
0	CM-PLC1	1	NX-SL3300	PLC CPU/Safety; Compatible with FSoE
0	CM-PLC1	2	NX-PF0630	IO Power Supply
0	CM-PLC1	3	NX-SID800	8ch Safety Input
0	CM-PLC1	4	NX-SID800	8ch Safety Input
0	CM-PLC1	5	NX-SOD400	4ch Safety Output
0	CM-PLC1	6	NX-SOD400	4ch Safety Output
0	CM-PLC1	7	NX-ID4442	8ch Digital Input (PNP)
0	CM-PLC1	8	NX-OD4256	8ch Digital Output (PNP)
0	CM-PLC1	9	NX-OD4256	8ch Digital Output (PNP)
0	CM-PLC1	10	NX-PD1000	NX Unit Power Supply
0	CM-PLC1	11	NX-AD4204	8ch Analog Current Input 4-20mA 1/8000
0	CM-PLC1	12	NX-DA2203	2ch Analog Current Output 4-20mA 1/8000
0	CM-PLC1	13	NX-AD4608	8ch Analog Voltage Input +/-10V 1/30000
0	CM-PLC1	14	NX-DA3605	4ch Analog Voltage Output +/-10V 1/30000
0	CM-PLC1	15	NX-TS3204	4ch RTD Input
0	CM-PLC1	16	NX-END02	End Cover
1	CM-PLC2	0	NX-ECC203	EtherCAT Slave Coupler
1	CM-PLC2	1	NX-CIF210	RS-232C 2ch
1	CM-PLC2	2	NX-SID800	8ch Safety Input
1	CM-PLC2	3	NX-SID800	8ch Safety Input
1	CM-PLC2	4	NX-SOD400	4ch Safety Output
1	CM-PLC2	5	NX-SOD400	4ch Safety Output
1	CM-PLC2	6	NX-ID4442	8ch Digital Input (PNP)
1	CM-PLC2	7	NX-OD4256	8ch Digital Output (PNP)
1	CM-PLC2	8	NX-AD4608	8ch Analog Voltage Input +/-10V 1/30000
1	CM-PLC2	9	NX-DA3605	4ch Analog Voltage Output +/-10V 1/30000
1	CM-PLC2	10	NX-END02	End Cover
2	CL-MG-PG2	0	3PI1-006-41G0	Pirani/EtherCAT compatible
3	CL-MG-PG1	0	3CB5-G61-23G0	Capacitance Gauge/EtherCAT compatible
4	C0-SC-PG	0	3CB5-G61-23G0	Capacitance Gauge/EtherCAT compatible
5	FL-MG-PG	0	3CB5-G61-23G0	Capacitance Gauge/EtherCAT compatible
6	FL-HE-MFC	0	SEC-N117MGM,CS5,,MR.MG-R01,10SCCM,4CRL,He,	Massflow controller/EtherCAT compatible
7	CL-NC-MFC	0	SEC-N117MGM,CS5,,MR.MG-06,5SLM,4CRL,N2,	Massflow controller/EtherCAT compatible
8	CL-HE-MFC	0	SEC-N127MGM,CS5,,MR.MG-07,15SLM,4CRL,He,	Massflow controller/EtherCAT compatible

Group	Module#	Ch	Old No.	New No.	PLC I/O Type	Direction	Conversion Factor	EGU	Signal	Note
0	0	N/A	9-2-1	CM-PLC1	System	N/A	N/A	N/A	N/A	PLC CPU/General
0	1	N/A	9-2-1	CM-PLC1	System	N/A	N/A	N/A	N/A	PLC CPU/Safety
0	2	N/A	9-2-1	CM-PLC1	System	N/A	N/A	N/A	N/A	Power Supply for PLC I/O
0	3	0	9-2-1	CM-PB-SW1	Contact (Safety)	ToPlc	N/A	N/A	Emergency STOP (dual contact 1/2)	Panic Button
0	3	1	9-2-1	CM-PB-SW1	Contact (Safety)	ToPlc	N/A	N/A	Emergency STOP (dual contact 2/2)	Panic Button
0	3	2	9-2-1	CM-PB-SW2	Contact (Safety)	ToPlc	N/A	N/A	Reset	Reset Button
0	3	3	19-2-1	CM-PB-SW3	Contact (Safety)	ToPlc	N/A	N/A	Lock/Unlock	Disable C1-CV interlock
0	3	4	19-2-2	CM-EI	Contact (Safety)	ToPlc	N/A	N/A	External Interlock	from Monitoring PLC
0	3	5			Contact (Safety)	ToPlc	N/A	N/A	No Connection	
0	3	6			Contact (Safety)	ToPlc	N/A	N/A	No Connection	
0	3	7			Contact (Safety)	ToPlc	N/A	N/A	No Connection	
0	4	0	4-1-1	CL-MG-VP	Contact (Safety)	ToPlc	N/A	N/A	Contacts on Pump	Monitoring pump power supply
0	4	1	12-1-1	FL-MG-VP	Contact (Safety)	ToPlc	N/A	N/A	Contacts on Pump	Monitoring pump power supply
0	4	2	7-1-1	CL-HV	Contact (Safety)	ToPlc	N/A	N/A	EMERGENCY	
0	4	3	2-2-1	C1-ST	Contact (Safety)	ToPlc	N/A	N/A	C1 Shutter Opened	
0	4	4	2-2-1	C1-ST	Contact (Safety)	ToPlc	N/A	N/A	C1 Shutter Closed	
0	4	5			Contact (Safety)	ToPlc	N/A	N/A	No Connection	
0	4	6			Contact (Safety)	ToPlc	N/A	N/A	No Connection	
0	4	7			Contact (Safety)	ToPlc	N/A	N/A	No Connection	
0	5	0	7-1-1	CL-HV	Contact (Safety)	FromPlc	N/A	N/A	EXT. INTERLOCK	PLC->Interlock signal to IDX
0	5	1	7-1-1	CL-HV	Contact (Safety)	FromPlc	N/A	N/A	EXT. EMERGENCY	PLC->Emergency signal to IDX
0	5	2	7-1-1	CL-HV	Contact (Safety)	FromPlc	N/A	N/A	RESET	
0	5	3	2-2-1	C1-ST	Contact (Safety)	FromPlc	N/A	N/A	C1 Shutter Open/Close	
0	6	0	-	CM-EI	Contact (Safety)	FromPlc	N/A	N/A	Dew Point Alarm	Dew-point temperature alarm->Monitoring PLC
0	6	1			Contact (Safety)	FromPlc	N/A	N/A	No Connection	
0	6	2			Contact (Safety)	FromPlc	N/A	N/A	No Connection	
0	6	3			Contact (Safety)	FromPlc	N/A	N/A	No Connection	
0	7	0	7-1-1	CL-HV	Digital PNP	ToPlc	N/A	N/A	STAND-BY	Status
0	7	1	7-1-1	CL-HV	Digital PNP	ToPlc	N/A	N/A	OPERATE	Status
0	7	2	7-1-1	CL-HV	Digital PNP	ToPlc	N/A	N/A	DOOR	Status
0	7	3	7-1-1	CL-HV	Digital PNP	ToPlc	N/A	N/A	OCR	Status
0	7	4	7-1-1	CL-HV	Digital PNP	ToPlc	N/A	N/A	OPR	Status
0	7	5	7-1-1	CL-HV	Digital PNP	ToPlc	N/A	N/A	THERMAL	Status
0	7	6	7-1-1	CL-HV	Digital PNP	ToPlc	N/A	N/A	AIRFLOW	Status
0	7	7			Digital PNP	ToPlc	N/A	N/A	No Connection	
0	8	0	7-1-1	CL-HV	Digital PNP	FromPlc	N/A	N/A	STAND-BY ON	
0	8	1	7-1-1	CL-HV	Digital PNP	FromPlc	N/A	N/A	STAND-BY OFF	
0	8	2	7-1-1	CL-HV	Digital PNP	FromPlc	N/A	N/A	OPERATE ON	
0	8	3	7-1-1	CL-HV	Digital PNP	FromPlc	N/A	N/A	OPERATE OFF	
0	8	4	7-1-1	CL-HV	Digital PNP	FromPlc	N/A	N/A	BUZZER ON	
0	8	5	7-1-1	CL-HV	Digital PNP	FromPlc	N/A	N/A	BUZZER OFF	
0	8	6			Digital PNP	FromPlc	N/A	N/A	No Connection	
0	8	7			Digital PNP	FromPlc	N/A	N/A	No Connection	
0	9	0	20-1-1	F*-FL-AV	Digital PNP	FromPlc	N/A	N/A	Actuated Valve	AV3 equivalent of prototype; *: A, U or B
0	9	1	20-1-1	F*-SC-AV	Digital PNP	FromPlc	N/A	N/A	Actuated Valve	AV4 equivalent of prototype; *: A, U or B
0	9	2	-	CL-OW-PD	Digital PNP	FromPlc	N/A	N/A	LOCAL CONTROL FLAG	
0	9	3			Digital PNP	FromPlc	N/A	N/A	No Connection	
0	9	4			Digital PNP	FromPlc	N/A	N/A	No Connection	
0	9	5			Digital PNP	FromPlc	N/A	N/A	No Connection	
0	9	6			Digital PNP	FromPlc	N/A	N/A	No Connection	
0	9	7			Digital PNP	FromPlc	N/A	N/A	No Connection	
0	10	0	9-2-1	CM-PLC1	System		N/A	N/A		PLC Unit PWS
0	11	0	7-1-1	CL-HV	Analog Current	ToPlc	1/320	kV	VOLT.MON (0: 0V, 8000: 25kV)	
0	11	1	7-1-1	CL-HV	Analog Current	ToPlc	1/320	kV	VOLT.MON OUTPUT1(0: 0V, 8000: 25kV)	
0	11	2	7-1-1	CL-HV	Analog Current	ToPlc	1/320	kV	VOLT.MON OUTPUT2(0: 0V, 8000: 25kV)	
0	11	3	7-1-1	CL-HV	Analog Current	ToPlc	3/160	mA	CURR.MON OUTPUT1 (0: 0mA, 8000: 150mA)	
0	11	4	7-1-1	CL-HV	Analog Current	ToPlc	3/160	mA	CURR.MON OUTPUT2 (0: 0mA, 8000: 150mA)	
0	11	5	7-1-1	CL-HV	Analog Current	ToPlc	1/320	kV	Ep-k.MON (0: 0V, 8000: 25kV)	
0	11	6	-	CM-CW-FM0	Analog Current	ToPlc	1/40	L/min	Flow rate(0: 0L/min, 8000: 200L/min)	
0	11	7			Analog Current	ToPlc	N/A	N/A	No Connection	
0	12	0	7-1-1	CL-HV	Analog Current	FromPlc	1/40	mA	CURR.CONT (0: 0mA, 8000: 200mA)	
0	12	1			Analog Current	FromPlc	N/A	N/A	No Connection	
0	13	0	-	CL-OW-PT	Analog Voltage	ToPlc	1/1500	V	PZT POT(0: 0V, 15000:10V)	
0	13	1	-	CL-OW-PD	Analog Voltage	ToPlc	1/100	V	Output voltage monitor(0: 0V 15000: 150V)	
0	13	2	3-1-1	C0-SC-PS	Analog Voltage	ToPlc	2/3	V	DC offset Voltage Monitor(0: 0kV, 15000:10000V)	
0	13	3	3-1-4	C0-SC-LA	Analog Voltage	ToPlc	1/1500	V	Intensity(0:0V, 15000: 10V)	C0-SC-DT->C0-SC-DT preamplifier->C0-SC-LA
0	13	4	-	C0-SB-OM	Analog Voltage	ToPlc	1/1500	V	(0:0V, 15000: 10V)	OUT-HF terminal of Giga Corporation's OUTPUT MONITOR
0	13	5	2-2-3	C1-PM	Analog Voltage	ToPlc	1/50	W	Power (0:0 W, 15000: 300W)	Branch input from CL-OS
0	13	6	13-1-2	F*-FL-MFC	Analog Voltage	ToPlc	1/750	sccm	FLOW PV (0: 0, 7500: 100%F.S= 10sccm)	*: A, U or B
0	13	7	5-2-1	F*-SC-MFC	Analog Voltage	ToPlc	1/750	sccm	FLOW PV (0: 0, 7500: 100%F.S= 10sccm)	*: A, U or B
0	14	0	-	CL-OW-PD	Analog Voltage	FromPlc	1/100	V	PZT Control Voltage(0: 0V, 15000:150V)	
0	14	1	13-1-2	F*-FL-MFC	Analog Voltage	FromPlc	1/750	sccm	FLOW SV (0: 0, 7500: 100%F.S= 10sccm)	*: A, U or B
0	14	2	5-2-1	F*-SC-MFC	Analog Voltage	FromPlc	1/750	sccm	FLOW SV (0: 0, 7500: 100%F.S= 10sccm)	*: A, U or B
0	14	3			Analog Voltage	FromPlc	N/A	N/A	No Connection	
0	15	0	-	CM-CW-TS0	Analog RTD	ToPlc	1/100	degC	Temperature gauge	
0	15	1			Analog RTD	ToPlc	N/A	N/A	No Connection	
0	15	2			Analog RTD	ToPlc	N/A	N/A	No Connection	
0	15	3			Analog RTD	ToPlc	N/A	N/A	d	
0	16	0	9-2-1	CM-PLC1	System		N/A	N/A		End Cover

Group	Module#	Ch	Old No.	New No.	PLC I/O Type	Direction	Conversion Factor	EGU	Signal	Note
1	0		9-2-1	CM-PLC2	System		N/A	N/A		EtherCAT Coupler
1	1	0	10-5-1	FL-OM-CB	Serial 1/2ch		N/A	N/A	RS232C/FIR Stage Serial	RS232C/FIR stage
1	1	1			Serial 2/2ch		N/A	N/A	No Connection	
1	2	0	5-1-7	CL-HE-PG	Contact (Safety)	ToPlc	N/A	N/A	Set Point	He gas supply pressure
1	2	1	5-1-8	CL-NC-PG	Contact (Safety)	ToPlc	N/A	N/A	Set Point	N2/CO2 gas supply pressure
1	2	2			Contact (Safety)	ToPlc	N/A	N/A	No Connection	
1	2	3			Contact (Safety)	ToPlc	N/A	N/A	No Connection	
1	2	4	19-1-3	CM-WL	Contact (Safety)	ToPlc	N/A	N/A	Water Leakage Ditector	
1	2	5	19-2-1	C1-CV-SW	Contact (Safety)	ToPlc	N/A	N/A	C1 Cover Status	
1	2	6	16-1-2	FL-ST	Contact (Safety)	ToPlc	N/A	N/A	FL Shutter Opened LSw	
1	2	7	16-1-2	FL-ST	Contact (Safety)	ToPlc	N/A	N/A	FL Shutter Closed LSw	
1	3	0	2-2-2	C1-PM-M	Contact (Safety)	ToPlc	N/A	N/A	Mirror Inserted N.O	Location limit switch
1	3	1	2-2-2	C1-PM-M	Contact (Safety)	ToPlc	N/A	N/A	Mirror Inserted N.C	End limit switch
1	3	2	2-2-2	C1-PM-M	Contact (Safety)	ToPlc	N/A	N/A	Mirror Removed N.O	Location limit switch
1	3	3	2-2-2	C1-PM-M	Contact (Safety)	ToPlc	N/A	N/A	Mirror Removed N.C	End limit switch
1	3	4	6-1-3	C1-VL-M	Contact (Safety)	ToPlc	N/A	N/A	Mirror Inserted N.O	Location limit switch
1	3	5	6-1-3	C1-VL-M	Contact (Safety)	ToPlc	N/A	N/A	Mirror Inserted N.C	End limit switch
1	3	6	6-1-3	C1-VL-M	Contact (Safety)	ToPlc	N/A	N/A	Mirror Removed N.O	Location limit switch
1	3	7	6-1-3	C1-VL-M	Contact (Safety)	ToPlc	N/A	N/A	Mirror Removed N.C	End limit switch
1	4	0	5-1-6	CL-NC-AV	Contact (Safety)	FromPlc	N/A	N/A	STV Open/Close	Actuated Valve for N2/CO2 Gas
1	4	1	5-1-5	CL-HE-AV	Contact (Safety)	FromPlc	N/A	N/A	STV Open/Close	Actuated Valve for He Gas
1	4	2	16-1-2	FL-ST	Contact (Safety)	FromPlc	N/A	N/A	FL Shutter Open/Close	
1	4	3			Contact (Safety)	FromPlc	N/A	N/A	No Connection	
1	5	0	2-2-2	C1-PM-M	Contact (Safety)	FromPlc	N/A	N/A	Mirror Insert Enable	
1	5	1	2-2-2	C1-PM-M	Contact (Safety)	FromPlc	N/A	N/A	Mirror Pull-out Enable	
1	5	2	6-1-3	C1-VL-M2	Contact (Safety)	FromPlc	N/A	N/A	Mirror Insert Enable	
1	5	3	6-1-3	C1-VL-M2	Contact (Safety)	FromPlc	N/A	N/A	Mirror Pull-out Enable	
1	6	0			Digital PNP	ToPlc	N/A	N/A	No Connection	
1	6	1			Digital PNP	ToPlc	N/A	N/A	No Connection	
1	6	2			Digital PNP	ToPlc	N/A	N/A	No Connection	
1	6	3			Digital PNP	ToPlc	N/A	N/A	No Connection	
1	6	4			Digital PNP	ToPlc	N/A	N/A	No Connection	
1	6	5			Digital PNP	ToPlc	N/A	N/A	No Connection	
1	6	6			Digital PNP	ToPlc	N/A	N/A	No Connection	
1	6	7			Digital PNP	ToPlc	N/A	N/A	No Connection	
1	7	0	2-2-2	C1-PM-M	Digital PNP	FromPlc	N/A	N/A	Switch mirror movement direction	
1	7	1	6-1-3	C1-VL-M2	Digital PNP	FromPlc	N/A	N/A	Switch mirror movement direction	
1	7	2			Digital PNP	FromPlc	N/A	N/A	No Connection	
1	7	3			Digital PNP	FromPlc	N/A	N/A	No Connection	
1	7	4			Digital PNP	FromPlc	N/A	N/A	No Connection	
1	7	5			Digital PNP	FromPlc	N/A	N/A	No Connection	
1	7	6			Digital PNP	FromPlc	N/A	N/A	No Connection	
1	7	7			Digital PNP	FromPlc	N/A	N/A	No Connection	
1	8	0	なし	CL-GT1-DT	Analog Voltage	ToPlc	2/3	mV	Intensity(0:0mV, 15000:10000mV)	PDA10A/M
1	8	1	なし	CL-GT2-DT	Analog Voltage	ToPlc	2/3	mV	Intensity(0:0mV, 15000:10000mV)	PDA10A/M
1	8	2	なし	C0-PM	Analog Voltage	ToPlc	1/50	W	Power (0:0 W, 15000: 300W)	VEGA
1	8	3	11-3-1	FL-PM	Analog Voltage	ToPlc	1/50	W	Power (0:0 W, 15000: 300W)	VEGA
1	8	4	10-5-1	FL-OM-CB	Analog Voltage	ToPlc	1/1500	V	Monitor Voltage (0: 0V, 15000:10V)	FIR stage controller
1	8	5	4-2-5	C0-SC-PV	Analog Voltage	ToPlc	1/75	%	Aperture PV (0: 0% 7500: 100%)	Piezo valve
1	8	6	12-1-3	FL-MG-PV	Analog Voltage	ToPlc	1/75	%	Aperture PV (0: 0% 7500: 100%)	Piezo valve
1	8	7			Analog Voltage	ToPlc	N/A	N/A	No Connection	
1	9	0	4-2-5	C0-SC-PV	Analog Voltage	FromPlc	1/75	%	Aperture SV (0: 0% 7500: 100%)	Piezo valve
1	9	1	12-1-3	FL-MG-PV	Analog Voltage	FromPlc	1/75	%	Aperture SV (0: 0% 7500: 100%)	Piezo valve
1	9	2			Analog Voltage	FromPlc	N/A	N/A	No Connection	
1	9	3			Analog Voltage	FromPlc	N/A	N/A	No Connection	
1	10	0	9-2-1	CM-PLC2	System		N/A	N/A		End Cover

#	Device	EPICS PV Name	EPICS Record Type	Conversion Factor	EGU	OPCUA Variable Name	Structure element (Only if the type of OPCUA variable is structure)	PLC Structure Def	PLC Variable Type	Physical Channel	Note
0	CM-PLC1		bi	N/A	N/A	CM_PLC1_sSts	bMode	sStsPLC	BOOL	N/A	0: LOCAL / 1: REMOTE
1	CM-PLC1		mbbiDirect	N/A	N/A		nClckSummary1	sStsPLC	WORD (16bit)	N/A	
2	CM-PLC1		mbbiDirect	N/A	N/A		nClckSummary2	sStsPLC	WORD (16bit)	N/A	
3	CM-PLC1		mbbiDirect	N/A	N/A		nWarnSummary1	sStsPLC	WORD (16bit)	N/A	
4	CM-PLC1		mbbiDirect	N/A	N/A		nWarnSummary2	sStsPLC	WORD (16bit)	N/A	
5	CL-HV		mbbiDirect	N/A	N/A	CL_HV_sSts	nStsSummary	sStsCLHV	WORD (16bit)	N/A	
6	CL-HV		ai	1/320	kV		nVoltMon	sStsCLHV	UINT (16bit)	CM-PLC1/Unit#11/Ch#0	
7	CL-HV		ai	1/320	kV		nVoltMonOutput1	sStsCLHV	UINT (16bit)	CM-PLC1/Unit#11/Ch#1	
8	CL-HV		ai	1/320	kV		nVoltMonOutput2	sStsCLHV	UINT (16bit)	CM-PLC1/Unit#11/Ch#2	
9	CL-HV		ai	3/160	mA		nCurrMonOutput1	sStsCLHV	UINT (16bit)	CM-PLC1/Unit#11/Ch#3	
10	CL-HV		ai	3/160	mA		nCurrMonOutput2	sStsCLHV	UINT (16bit)	CM-PLC1/Unit#11/Ch#4	
11	CL-HV		ai	1/320	kV		nEpkMon	sStsCLHV	UINT (16bit)	CM-PLC1/Unit#11/Ch#5	
12	CL-HV		bo	N/A	N/A	CL_HV_sCntl	bReqStandbyOn	sCntlCLHV	BOOL	CM-PLC1/Unit#8/Ch#0	
13	CL-HV		bo	N/A	N/A		bReqStandbyOff	sCntlCLHV	BOOL	CM-PLC1/Unit#8/Ch#1	
14	CL-HV		bo	N/A	N/A		bReqOperateOn	sCntlCLHV	BOOL	CM-PLC1/Unit#8/Ch#2	
15	CL-HV		bo	N/A	N/A		bReqOperateOff	sCntlCLHV	BOOL	CM-PLC1/Unit#8/Ch#3	
16	CL-HV		bo	N/A	N/A		bReqBuzzerOn	sCntlCLHV	BOOL	CM-PLC1/Unit#8/Ch#4	
17	CL-HV		bo	N/A	N/A		bReqBuzzerOff	sCntlCLHV	BOOL	CM-PLC1/Unit#8/Ch#5	
18	CL-HV		ao	1/40	mA		nCurrent	sCntlCLHV	UINT (16bit)	CM-PLC1/Unit#12/Ch#0	
19	CL-HV		mbbi	N/A	N/A	CL_HV_sSeqSts	nState	sSeqSts	WORD (16bit)	N/A	
20	CL-HV		longin	N/A	N/A		nCycle	sSeqSts	UINT (16bit)	N/A	
21	CL-HV		longout	N/A	N/A		nMaxCycle	sSeqSts	UINT (16bit)	N/A	
22	CL-HV		mbbiDirect	N/A	N/A		nErrorCode	sSeqSts	WORD (16bit)	N/A	Added due to unknown cause at the end of error in prototype system.
23	CL-HV		bo	N/A	N/A	CL_HV_sSeqCntl	bStart	sSeqCntl	BOOL	N/A	
24	CL-HV		bo	N/A	N/A		bAbort	sSeqCntl	BOOL	N/A	
25	CL-HV		bo	N/A	N/A		bReset	sSeqCntl	BOOL	N/A	
26	CL-HV		ao	1	-		fPDRatio	sSeqCntl	REAL (32bit)	N/A	
27	CL-HV		ao	1	s		fPDDelay	sSeqCntl	REAL (32bit)	N/A	
28	CL-HV		ao	1	slm		fFlowNC##	sSeqCntl	REAL (32bit)	N/A	##: 01~32
29	CL-HV		ao	1	slm		fFlowHE##	sSeqCntl	REAL (32bit)	N/A	##: 01~32
30	CL-HV		ao	1	mA		fCurrent##	sSeqCntl	REAL (32bit)	N/A	##: 01~32
31	CL-HV		ao	1	s		fTGas##	sSeqCntl	REAL (32bit)	N/A	##: 01~32
32	CL-HV		ao	1	s		fTHV##	sSeqCntl	REAL (32bit)	N/A	##: 01~32
33	CL-GT1-DT		ai	2/3	mV	CL_GT1_DT_nIntensity			UINT (16bit)	CM-PLC2/Unit#8/Ch#0	
34	CL-GT2-DT		ai	2/3	mV	CL_GT2_DT_nIntensity			UINT (16bit)	CM-PLC2/Unit#8/Ch#1	
35	CL-OW-PD		mbbi	N/A	N/A	CL_OW_PD_sSts	nMode	sStsCLOWPD	WORD (16bit)	N/A	
36	CL-OW-PD		ai	1/100	V		nPztPV	sStsCLOWPD	UINT (16bit)	CM-PLC1/Unit#13/Ch#1	
37	CL-OW-PD		ai	1/1500	V		nPot	sStsCLOWPD	UINT (16bit)	CM-PLC1/Unit#13/Ch#0	
38	CL-OW-PD		longin	1	s		nPID_P	sStsCLOWPD	UINT (16bit)	N/A	
39	CL-OW-PD		longin	1	s		nPID_I	sStsCLOWPD	UINT (16bit)	N/A	
40	CL-OW-PD		longin	1	s		nPID_D	sStsCLOWPD	UINT (16bit)	N/A	
41	CL-OW-PD		mbbo	N/A	N/A	CL_OW_PD_sCntl	nMode	sCntlCLOWPD	WORD (16bit)	N/A	
42	CL-OW-PD		ao	1/100	V		nPztSP	sStsCLOWPD	UINT (16bit)	CM-PLC1/Unit#14/Ch#0	
43	CL-OW-PD		ao	100	V		nManSP	sCntlCLOWPD	UINT (16bit)	N/A	
44	CL-OW-PD		longout	1	s		nPID_P	sCntlCLOWPD	UINT (16bit)	N/A	
45	CL-OW-PD		longout	1	s		nPID_I	sCntlCLOWPD	UINT (16bit)	N/A	
46	CL-OW-PD		longout	1	s		nPID_D	sCntlCLOWPD	UINT (16bit)	N/A	
47	C0-PM		ai	1/50	W	C0_PM_nIntensity			UINT (16bit)	CM-PLC2/Unit#8/Ch#2	
48	C0-SB-OM		ai	1/1500	V	C0_SB_OM_nVolt			UINT (16bit)	CM-PLC1/Unit#13/Ch#4	Output of the output monitor
49	C0-SC-PS		ai	1/1500	V	C0_SC_PS_nVolt			UINT (16bit)	CM-PLC1/Unit#13/Ch#2	DC Offset Voltage
50	C0-SC-LA		ai	1/1500	V	C0_SC_LA_nVolt			UINT (16bit)	CM-PLC1/Unit#13/Ch#3	
51	C1-ST		mbbiDirect	N/A	N/A	C1_ST_sSts	nSummary	sStsST	WORD (16bit)	N/A	
52	C1-ST		bi	N/A	N/A		bOpenClose	sStsST	BOOL	N/A	
53	C1-ST		bo	N/A	N/A	C1_ST_sCntl	bReqOpen	sCntlOpCl	BOOL	N/A	
54	C1-ST		bo	N/A	N/A		bReqClose	sCntlOpCl	BOOL	N/A	
55	C1-VL-M2		mbbiDirect	N/A	N/A	C1_VL_M2_sSts	nSummary	sStsMM	WORD (16bit)	N/A	
56	C1-VL-M2		bi	N/A	N/A		bPosition	sStsMM	BOOL	N/A	
57	C1-VL-M2		bo	N/A	N/A	C1_VL_M2_sCntl	bReqInsert	sCntlMM	BOOL	N/A	
58	C1-VL-M2		bo	N/A	N/A		bReqRemove	sCntlMM	BOOL	N/A	
59	C1-PM-M		mbbiDirect	N/A	N/A	C1_PM_M_sSts	nSummary	sStsMM	WORD (16bit)	N/A	
60	C1-PM-M		bi	N/A	N/A		bPosition	sStsMM	BOOL	N/A	
61	C1-PM-M		bo	N/A	N/A	C1_PM_M_sCntl	bReqInsert	sCntlMM	BOOL	N/A	
62	C1-PM-M		bo	N/A	N/A		bReqRemove	sCntlMM	BOOL	N/A	

#	Device	EPICS PV Name	EPICS Record Type	Conversion Factor	EGU	OPCUA Variable Name	Structure element (Only if the type of OPCUA variable is structure)	PLC Structure Def	PLC Variable Type	Physical Channel	Note
63	C1-PM	ai		1/50	W	C1_PM_nIntensity			UINT (16bit)	CM-PLC1/Unit#13/Ch#5	
64	FL-OM-CB	bi		N/A	N/A	FL_OM_CB_sSts	bRemote	sStsFLOMCB	BOOL	N/A	0: LOCAL / 1: REMOTE
65	FL-OM-CB	bi		N/A	N/A		bAuto	sStsFLOMCB	BOOL	N/A	
66	FL-OM-CB	bi		N/A	N/A		bBusy	sStsFLOMCB	BOOL	N/A	
67	FL-OM-CB	bi		N/A	N/A		bOverHeat	sStsFLOMCB	BOOL	N/A	
68	FL-OM-CB	bi		N/A	N/A		bPhase	sStsFLOMCB	BOOL	N/A	0: POSITIVE / 1: NEGATIVE
69	FL-OM-CB	ai		1/10	s		nAverage	sStsFLOMCB	UINT (16bit)	N/A	
70	FL-OM-CB	ai		1/1000	V		nReference	sStsFLOMCB	UINT (16bit)	N/A	
71	FL-OM-CB	ai		1/10	um/s		nSpeed	sStsFLOMCB	UINT (16bit)	N/A	
72	FL-OM-CB	ai		1/10	um		nJogStep	sStsFLOMCB	UINT (16bit)	N/A	
73	FL-OM-CB	ai		1/1000	V		nSignal	sStsFLOMCB	UINT (16bit)	N/A	
74	FL-OM-CB	ai		1/1000	mm		nAbsPos	sStsFLOMCB	UINT (16bit)	N/A	
75	FL-OM-CB	ai		1/1000	mm		nRelPos	sStsFLOMCB	UINT (16bit)	N/A	
76	FL-OM-CB	ai		1/1500	V		nMonitor	sStsFLOMCB	UINT (16bit)	CM-PLC2/Unit#8/Ch#4	
77	FL-OM-CB	bo		N/A	N/A	FL_OM_CB_sCntl	bCommReset	sCntlFLOMCB	BOOL	N/A	
78	FL-OM-CB	bo		N/A	N/A		bReqManual	sCntlFLOMCB	BOOL	N/A	
79	FL-OM-CB	bo		N/A	N/A		bReqAuto	sCntlFLOMCB	BOOL	N/A	
80	FL-OM-CB	bo		N/A	N/A		bSetParam	sCntlFLOMCB	BOOL	N/A	
81	FL-OM-CB	bo		N/A	N/A		bJogP	sCntlFLOMCB	BOOL	N/A	
82	FL-OM-CB	bo		N/A	N/A		bJogM	sCntlFLOMCB	BOOL	N/A	
83	FL-OM-CB	bo		N/A	N/A		bMoveP	sCntlFLOMCB	BOOL	N/A	
84	FL-OM-CB	bo		N/A	N/A		bMoveM	sCntlFLOMCB	BOOL	N/A	
85	FL-OM-CB	bo		N/A	N/A		bExecOrigin	sCntlFLOMCB	BOOL	N/A	
86	FL-OM-CB	bo		N/A	N/A		bStop	sCntlFLOMCB	BOOL	N/A	
87	FL-OM-CB	longout		N/A	N/A		nPhase	sCntlFLOMCB	UINT (16bit)	N/A	0: POSITIVE / 1: NEGATIVE
88	FL-OM-CB	ao		1/10	s		nAverage	sCntlFLOMCB	UINT (16bit)	N/A	
89	FL-OM-CB	ao		1/1000	V		nReference	sCntlFLOMCB	UINT (16bit)	N/A	
90	FL-OM-CB	ao		1/10	um/s		nSpeed	sCntlFLOMCB	UINT (16bit)	N/A	
91	FL-OM-CB	ao		1/10	um		nJogStep	sCntlFLOMCB	UINT (16bit)	N/A	
92	FL-OM-CB	ao		1/1000	V		nSignal	sCntlFLOMCB	UINT (16bit)	N/A	
93	FL-OM-CB	ao		1/1000	mm		nAbsPos	sCntlFLOMCB	UINT (16bit)	N/A	
94	FL-OM-CB	ao		1/1000	mm		nRelPos	sCntlFLOMCB	UINT (16bit)	N/A	
95	FL-ST	mbbiDirect		N/A	N/A	FL_ST_sSts	nSummary	sStsST	WORD (16bit)	N/A	
96	FL-ST	bi		N/A	N/A		bOpenClose	sStsST	BOOL	N/A	
97	FL-ST	bo		N/A	N/A	FL_ST_sCntl	bReqOpen	sCntlOpCl	BOOL	N/A	
98	FL-ST	bo		N/A	N/A		bReqClose	sCntlOpCl	BOOL	N/A	
99	FL-PM	ai		1/50	W	FL-PM_nIntensity			UINT (16bit)	CM-PLC2/Unit#8/Ch#3	
100	CL-HE-AV	bi		N/A	N/A	CL_HE_AV_bSts			BOOL	N/A	
101	CL-HE-AV	bo		N/A	N/A	CL_HE_AV_sCntl	bReqOpen	sCntlOpCl	BOOL	N/A	
102	CL-HE-AV	bo		N/A	N/A		bReqClose	sCntlOpCl	BOOL	N/A	
103	CL-NC-AV	bi		N/A	N/A	CL_HE_AV_bSts			BOOL	N/A	
104	CL-NC-AV	bo		N/A	N/A	CL_HE_AV_sCntl	bReqOpen	sCntlOpCl	BOOL	N/A	
105	CL-NC-AV	bo		N/A	N/A		bReqClose	sCntlOpCl	BOOL	N/A	
106	CL-MG-PG2	bi		N/A	N/A	CL_MG_PG2_Sts	bValid	sStsGauge	BOOL	N/A	
107	CL-MG-PG2	bi		N/A	N/A		bOverrange	sStsGauge	BOOL	N/A	
108	CL-MG-PG2	bi		N/A	N/A		bUnderrange	sStsGauge	BOOL	N/A	
109	CL-MG-PG2	ai		100	Pa		fSensorValue	sStsGauge	REAL	N/A	
110	CL-MG-PG1	bi		N/A	N/A	CL_MG_PG1_Sts	bValid	sStsGauge	BOOL	N/A	
111	CL-MG-PG1	bi		N/A	N/A		bOverrange	sStsGauge	BOOL	N/A	
112	CL-MG-PG1	bi		N/A	N/A		bUnderrange	sStsGauge	BOOL	N/A	
113	CL-MG-PG1	ai		100	Pa		fSensorValue	sStsGauge	REAL (32bit)	N/A	
114	C0-SC-PG	bi		N/A	N/A	C0_SC_PG_Sts	bValid	sStsGauge	BOOL	N/A	
115	C0-SC-PG	bi		N/A	N/A		bOverrange	sStsGauge	BOOL	N/A	
116	C0-SC-PG	bi		N/A	N/A		bUnderrange	sStsGauge	BOOL	N/A	
117	C0-SC-PG	ai		100	Pa		fSensorValue	sStsGauge	REAL (32bit)	N/A	
118	FL-MG-PG	bi		N/A	N/A	FL_MG_PG_Sts	bValid	sStsGauge	BOOL	N/A	
119	FL-MG-PG	bi		N/A	N/A		bOverrange	sStsGauge	BOOL	N/A	
120	FL-MG-PG	bi		N/A	N/A		bUnderrange	sStsGauge	BOOL	N/A	
121	FL-MG-PG	ai		100	Pa		fSensorValue	sStsGauge	REAL (32bit)	N/A	
122	FL-HE-MFC	mbbiDirect		N/A	N/A	FL_HE_MFC_Sts	nStsSummary	sStsMFC	WORD (16bit)	N/A	
123	FL-HE-MFC	ai		1	sccm		fFlowPV	sStsMFC	REAL (32bit)	N/A	
124	FL-HE-MFC	ai		1	sccm		fFlowSPRB	sStsMFC	REAL (32bit)	N/A	
125	FL-HE-MFC	mbbo		N/A	N/A	FL_HE_MFC_Cntl	nActuatorCntl	sCntlMFC	USINT (8bit)	N/A	

#	Device	EPICS PV Name	EPICS Record Type	Conversion Factor	EGU	OPCUA Variable Name	Structure element (Only if the type of OPCUA variable is structure)	PLC Structure Def	PLC Variable Type	Physical Channel	Note
126	FL-HE-MFC	ao		1	sccm	fFlowSP		sCntlMFC	REAL (32bit)	N/A	
127	FL-HE-MFC	ao		1	%	fActuatorPosSP		sCntlMFC	REAL (32bit)	N/A	
128	CL-NC-MFC	mbbiDirect		N/A	N/A	CL_NC_MFC_Sts	nStsSummary	sStsMFC	WORD (16bit)	N/A	
129	CL-NC-MFC	ai		1	slm	fFlowPV		sStsMFC	REAL (32bit)	N/A	
130	CL-NC-MFC	ai		1	slm	fFlowSPRB		sStsMFC	REAL (32bit)	N/A	
131	CL-NC-MFC	mbbo		N/A	N/A	CL_NC_MFC_Cntl	nActuatorCntl	sCntlMFC	USINT (8bit)	N/A	
132	CL-NC-MFC	ao		1	slm	fFlowSP		sCntlMFC	REAL (32bit)	N/A	
133	CL-NC-MFC	ao		1	%	fActuatorPosSP		sCntlMFC	REAL (32bit)	N/A	
134	CL-HE-MFC	mbbiDirect		N/A	N/A	CL_HE_MFC_Sts	nStsSummary	sStsMFC	WORD (16bit)	N/A	
135	CL-HE-MFC	ai		1	slm	fFlowPV		sStsMFC	REAL (32bit)	N/A	
136	CL-HE-MFC	ai		1	slm	fFlowSPRB		sStsMFC	REAL (32bit)	N/A	
137	CL-HE-MFC	mbbo		N/A	N/A	CL_HE_MFC_Cntl	nActuatorCntl	sCntlMFC	USINT (8bit)	N/A	
138	CL-HE-MFC	ao		1	slm	fFlowSP		sCntlMFC	REAL (32bit)	N/A	
139	CL-HE-MFC	ao		1	%	fActuatorPosSP		sCntlMFC	REAL (32bit)	N/A	
140	CL-MG-VP	bi		N/A	N/A	CL_MG_VP_bRunning			BOOL	CM-PLC1/Unit#4/Ch#0	
141	FL-MG-VP	bi		N/A	N/A	FL_MG_VP_bRunning			BOOL	CM-PLC1/Unit#4/Ch#1	
142	F*-FL-AV	bi		N/A	N/A	F*_FL_AV_bSts			BOOL	N/A	
143	F*-FL-AV	bo		N/A	N/A	F*_FL_AV_sCntl	bReqOpen	sCntlOpCl	BOOL	N/A	
144	F*-FL-AV	bo		N/A	N/A		bReqClose	sCntlOpCl	BOOL	N/A	
145	F*-SC-AV	bi		N/A	N/A	F*_FL_AV_bSts			BOOL	N/A	
146	F*-SC-AV	bo		N/A	N/A	F*_FL_AV_sCntl	bReqOpen	sCntlOpCl	BOOL	N/A	
147	F*-SC-AV	bo		N/A	N/A		bReqClose	sCntlOpCl	BOOL	N/A	
148	F*-FL-MFC	ai		1/750	sccm	F*_FL_MFC_fFlowPV			UINT (16bit)	CM-PLC1/Unit#13/Ch#6	
149	F*-FL-MFC	ao		1/750	sccm	F*_FL_MFC_fFlowSP			UINT (16bit)	CM-PLC1/Unit#14/Ch#1	
150	F*-SC-MFC	ai		1/750	sccm	F*_SC_MFC_fFlowPV			UINT (16bit)	CM-PLC1/Unit#13/Ch#7	
151	F*-SC-MFC	ao		1/750	sccm	F*_SC_MFC_fFlowSP			UINT (16bit)	CM-PLC1/Unit#14/Ch#2	
152	C0-SC-PV	bi		N/A	N/A	C0_SC_PV_sSts	nMode	sStsPV	BOOL	N/A	
153	C0-SC-PV	longin		1	s		nPID_P	sStsPV	UINT (16bit)	N/A	
154	C0-SC-PV	longin		1	s		nPID_I	sStsPV	UINT (16bit)	N/A	
155	C0-SC-PV	longin		1	s		nPID_D	sStsPV	UINT (16bit)	N/A	
156	C0-SC-PV	ai		1/75	%		nApparturePV	sStsPV	UINT (16bit)	CM-PLC2/Unit#8/Ch#5	
157	C0-SC-PV	bo		N/A	N/A	C0_SC_PV_sCntl	nMode	sCntlIPV	BOOL	N/A	
158	C0-SC-PV	longout		1	s		nPID_P	sCntlIPV	UINT (16bit)	N/A	
159	C0-SC-PV	longout		1	s		nPID_I	sCntlIPV	UINT (16bit)	N/A	
160	C0-SC-PV	longout		1	s		nPID_D	sCntlIPV	UINT (16bit)	N/A	
161	C0-SC-PV	ao		1/75	%		nAppartureSP	sCntlIPV	UINT (16bit)	CM-PLC2/Unit#9/Ch#0	
162	C0-SC-PV	ao		1	Pa		fPressureSP	sCntlIPV	REAL (32bit)	N/A	
163	FL-MG-PV	bi		N/A	N/A	FL_MG_PV_sSts	nMode	sStsPV	BOOL	N/A	
164	FL-MG-PV	longin		1	s		nPID_P	sStsPV	UINT (16bit)	N/A	
165	FL-MG-PV	longin		1	s		nPID_I	sStsPV	UINT (16bit)	N/A	
166	FL-MG-PV	longin		1	s		nPID_D	sStsPV	UINT (16bit)	N/A	
167	FL-MG-PV	ai		1/75	%		nApparturePV	sStsPV	UINT (16bit)	CM-PLC2/Unit#8/Ch#6	
168	FL-MG-PV	bo		N/A	N/A	FL_MG_PV_sCntl	nMode	sCntlIPV	BOOL	N/A	
169	FL-MG-PV	longout		1	s		nPID_P	sCntlIPV	UINT (16bit)	N/A	
170	FL-MG-PV	longout		1	s		nPID_I	sCntlIPV	UINT (16bit)	N/A	
171	FL-MG-PV	longout		1	s		nPID_D	sCntlIPV	UINT (16bit)	N/A	
172	FL-MG-PV	ao		1/75	%		nAppartureSP	sCntlIPV	UINT (16bit)	CM-PLC2/Unit#9/Ch#1	
173	FL-MG-PV	ao		1	Pa		fPressureSP	sCntlIPV	REAL (32bit)	N/A	
174	CM-CW-FM0	ai		1/40	L/min	CM_CW_FM0_fFlow			UINT (16bit)	CM-PLC1/Unit#11/Ch#6	
175	CM-CW-TS0	ai		1	degC	CM_CW_TS0_fTemp			UINT (16bit)	CM-PLC1/Unit#15/Ch#0	
176	CM-TH	mbbiDirect		N/A	N/A	CM_TH_sSts	nStsSummary	sStsTH	WORD (16bit)	N/A	
177	CM-TH	ai		1	degC	fTemp		sStsTH	REAL (32bit)	N/A	
178	CM-TH	ai		1	%RH	fRH		sStsTH	REAL (32bit)	N/A	
179	CM-TH	ai		1	degC	fDewPoint		sStsTH	REAL (32bit)	N/A	
180	CM-TH	bo		N/A	N/A	CM_TH_bCommReset			BOOL	N/A	
181	CM-PB	bo		N/A	N/A	CM_PB_bSoftReset			BOOL	N/A	
182	CM-TP	bi		N/A	N/A	CM_TP_bRemote			BOOL	N/A	

Bitmap (mbbi, mbbo)

#	Variable	type	Raw Value	String Label
1	CL_HV_sSeqSts.nState	mbbi	0 (Reserved)	
2			1 Idle	
3			2 Set Flow Rate	
4			3 Wait Flow Stabilization	
5			4 Set HV	
6			5 Watch	
7			6 Cycle End	
8			7 Done	
9			8 Abort	
10			9 Error	
17	CL_OW_PD_sSts.nMode	mbbi	0 (Reserved)	
18			1 Manual (Local POT)	
19			2 Manual	
20			3 Auto Sweap	
21			4 Auto PID	
33	CL_OW_PD_sCntl.nMode	mbbo	0 (Reserved)	
34			1 Manual (Local POT)	
35			2 Manual	
36			3 Auto Sweap	
37			4 Auto PID	
49	FL_HE_MFC_Cntl.nActuatorCntl	mbbo	0 Flow control (Feedback)	
50			1 Valve Drive Voltage (Position)	
51			2 Fully Open	
52			3 Fully Close	
53			4 Fixed valve drive voltage (Freeze Position)	
57	CL_NC_MFC_Cntl.nActuatorCntl	mbbo	0 Flow control (Feedback)	
58			1 Valve Drive Voltage (Position)	
59			2 Fully Open	
60			3 Fully Close	
61			4 Fixed valve drive voltage (Freeze Position)	
65	CL_HE_MFC_Cntl.nActuatorCntl	mbbo	0 Flow control (Feedback)	
66			1 Valve Drive Voltage (Position)	
67			2 Fully Open	
68			3 Fully Close	
69			4 Fixed valve drive voltage (Freeze Position)	

#	Variable	Bit	Description	Note
1	CM_PLC1_sSts.nIclkSummary1	0(LSB)	CL-NC-AV Operation Permission	1: Permitted / 0: Prohibited
2		1	CL-HE-AV Operation Permission	1: Permitted / 0: Prohibited
3		2	CL-HV Operation Permission	1: Permitted / 0: Prohibited
4		3	C1-ST Operation Permission	1: Permitted / 0: Prohibited
5		4	C1-PM-M Operation Permission	1: Permitted / 0: Prohibited
6		5	C1-VL-M2 Operation Permission	1: Permitted / 0: Prohibited
7		6	CL-HE-MFC Operation Permission	1: Permitted / 0: Prohibited
8		7	CL-NC-MFC Operation Permission	1: Permitted / 0: Prohibited
9		8	FL-HE-MFC Operation Permission	1: Permitted / 0: Prohibited
10		9	FL-ST Operation Permission	1: Permitted / 0: Prohibited
11		10	FL-OM-CB Operation Permission	1: Permitted / 0: Prohibited
12		11	(Reserved)	
13		12	(Reserved)	
14		13	(Reserved)	
15		14	(Reserved)	
16		15	(Reserved)	
17	CM_PLC1_sSts.nIclkSummary2	0(LSB)	CM-PLC1 Safety Communication Status	1: Normal / 0: Error
18		1	CM-PLC2 Safety Communication Status	1: Normal / 0: Error
19		2	CM-WL Water Leakage Detection	1: Normal / 0: Water Leakage
20		3	CM-PB-SW1 Status	1: Normal / 0: SW1 Emergency STOP Activated
21		4	CM-PB-SW3 Status	1: SW3 Enabled (bypass C1-CV-SW interlock)
22		5	C1-CV-SW Status	1: Normal / 0: Cover Removed
23		6	CM-EI Dew Point Alarm	1: Normal / 0: Alarm
24		7	CM-EI External Interlock Signal from Monitoring PLC	1: Normal / 0: Interlock Activated
25		8	CL-HE-PG SetPoint Status	1: Normal / 0: Error
26		9	CL-NC-PG SetPoint Status	1: Normal / 0: Error
27		10	(Reserved)	
28		11	(Reserved)	
29		12	(Reserved)	
30		13	(Reserved)	
31		14	(Reserved)	
32		15	(Reserved)	
33	CM_PLC1_sSts.nWarnSummary1	0(LSB)	EtherCAT Slave Communication Status (CM-PLC2)	1: Normal / 0: Error
34		1	EtherCAT Slave Communication Status (CL-MG-PG2)	1: Normal / 0: Error
35		2	EtherCAT Slave Communication Status (CL-MG-PG1)	1: Normal / 0: Error
36		3	EtherCAT Slave Communication Status (C0-SC-PG)	1: Normal / 0: Error
37		4	EtherCAT Slave Communication Status (FL-MG-PG)	1: Normal / 0: Error
38		5	EtherCAT Slave Communication Status (FL-HE-MFC)	1: Normal / 0: Error
39		6	EtherCAT Slave Communication Status (CL-NC-MFC)	1: Normal / 0: Error
40		7	EtherCAT Slave Communication Status (CL-HE-MFC)	1: Normal / 0: Error
41		8	(Reserved)	
42		9	(Reserved)	
43		10	(Reserved)	
44		11	(Reserved)	
45		12	(Reserved)	
46		13	(Reserved)	
47		14	(Reserved)	
48		15	(Reserved)	
49	CM_PLC1_sSts.nWarnSummary2	0(LSB)	(Reserved)	
50		1	(Reserved)	
51		2	(Reserved)	
52		3	(Reserved)	
53		4	(Reserved)	
54		5	(Reserved)	
55		6	(Reserved)	
56		7	(Reserved)	
57		8	(Reserved)	
58		9	(Reserved)	
59		10	(Reserved)	
60		11	(Reserved)	
61		12	(Reserved)	
62		13	(Reserved)	
63		14	(Reserved)	
64		15	(Reserved)	

#	Variable	Bit	Description	Note
65	CL_HV_sSts.nStsSummary	0(LSB) EMERGENCY		1: Emergency / 0: Normal
66		1 (Reserved)		
67		2 (Reserved)		
68		3 (Reserved)		
69		4 (Reserved)		
70		5 (Reserved)		
71		6 (Reserved)		
72		7 (Reserved)		
73		8 CL-HV STAND-BY		1: ON / 0: OFF
74		9 CL-HV OPERATE		1: ON / 0: OFF
75		10 CL-HV DOOR		1: Error / 0: Normal
76		11 CL-HV OCR		1: Error / 0: Normal
77		12 CL-HV OPR		1: Error / 0: Normal
78		13 CL-HV THERMAL		1: Error / 0: Normal
79		14 CL-HV AIRFLOW		1: Error / 0: Normal
80		15 (Reserved)		
81	CL_HV_sSeqSts.nErrorCode	0(LSB) PD Threshold Error		1: PD Threshold Check Failed
82		1 Current Unbalance Error		1: Current Balance Check Failed
83		2 Flow Setting Error		1: CL-HE-MFC Flow Setting Failed
84		3 Flow Setting Error		1: CL-NC-MFC Flow Setting Failed
85		4 (Reserved)		
86		5 (Reserved)		
87		6 (Reserved)		
88		7 Abort by User		1: Aborted by user
89		8 (Reserved)		
90		9 Error/Abort		1: Error/Abort on Sequence State #2
91		10 Error/Abort		1: Error/Abort on Sequence State #3
92		11 (Reserved)		
93		12 Error/Abort		1: Error/Abort on Sequence State #5
94		13 Error/Abort		1: Error/Abort on Sequence State #6
95		14 (Reserved)		
96		15 (Reserved)		
97	C1_VL_M2_sSts.nSummary	0(LSB) Device Fault		1: Anomaly (e.g. limit switch mismatch)
98		1 IsInserted		1: Exists on the light path
99		2 IsRemoved		1: Moved out of the light path
100		3 (Reserved)		
101		4 (Reserved)		
102		5 (Reserved)		
103		6 (Reserved)		
104		7 (Reserved)		
105		8 (Reserved)		
106		9 (Reserved)		
107		10 (Reserved)		
108		11 (Reserved)		
109		12 (Reserved)		
110		13 (Reserved)		
111		14 (Reserved)		
112		15 (Reserved)		
113	C1_PM_M_sSts.nSummary	0(LSB) Device Fault		1: Anomaly (e.g. limit switch mismatch)
114		1 IsInserted		1: Exists on the light path
115		2 IsRemoved		1: Moved out of the light path
116		3 (Reserved)		
117		4 (Reserved)		
118		5 (Reserved)		
119		6 (Reserved)		
120		7 (Reserved)		
121		8 (Reserved)		
122		9 (Reserved)		
123		10 (Reserved)		
124		11 (Reserved)		
125		12 (Reserved)		
126		13 (Reserved)		
127		14 (Reserved)		
128		15 (Reserved)		

#	Variable	Bit	Description	Note
129	C1_ST_sSts.nSummary	0(LSB)	Device Fault	1: Anomaly (e.g. limit switch mismatch)
130		1	IsOpened	1: Open
131		2	IsClosed	1: Closed
132		3	(Reserved)	
133		4	(Reserved)	
134		5	(Reserved)	
135		6	(Reserved)	
136		7	(Reserved)	
137		8	(Reserved)	
138		9	(Reserved)	
139		10	(Reserved)	
140		11	(Reserved)	
141		12	(Reserved)	
142		13	(Reserved)	
143		14	(Reserved)	
144		15	(Reserved)	
145	FL_ST_sSts.nSummary	0(LSB)	Device Fault	1: Anomaly (e.g. limit switch mismatch)
146		1	IsOpened	1: Open
147		2	IsClosed	1: Closed
148		3	(Reserved)	
149		4	(Reserved)	
150		5	(Reserved)	
151		6	(Reserved)	
152		7	(Reserved)	
153		8	(Reserved)	
154		9	(Reserved)	
155		10	(Reserved)	
156		11	(Reserved)	
157		12	(Reserved)	
158		13	(Reserved)	
159		14	(Reserved)	
160		15	(Reserved)	
161	FL_HE_MFC_Sts.nStsSummary	0(LSB)	Device Fault	1: Error (error, failure, etc.)
162		1	Service in Progress	SEC-N117 0x600F:01 Status / 1: Command object is being executed
163		2	Invalid Data Input	SEC-N117 0x600F:02 Status / 1: Invalid data set in RxPDO
164		3	Ramp Active	SEC-N117 0x600F:03 Status / 1: Ramp is being executed
165		4	Valve Control Mode (fully-open)	SEC-N117 0x600F:04 Status / 1: Fully open
166		5	Valve Control Mode (fully-closed)	SEC-N117 0x600F:05 Status / 1: Fully closed
167		6	Valve Control Mode (position control)	SEC-N117 0x600F:06 Status / 1: Valve drive voltage under direct control
168		7	Communication Error	1: Communication error
169		8	Active Device Warning	SEC-N117 0xF380:00 Active Exception Status bit0
170		9	Active Manufacturer Warning	SEC-N117 0xF380:00 Active Exception Status bit1
171		10	Active Device Error	SEC-N117 0xF380:00 Active Exception Status bit2
172		11	Active Manufacturer Error	SEC-N117 0xF380:00 Active Exception Status bit3
173		12	(Reserved)	SEC-N117 0xF380:00 Active Exception Status bit4 (Reserved/Always 0)
174		13	(Reserved)	SEC-N117 0xF380:00 Active Exception Status bit5 (Reserved/Always 0)
175		14	(Reserved)	SEC-N117 0xF380:00 Active Exception Status bit6 (Reserved/Always 0)
176		15	(Reserved)	SEC-N117 0xF380:00 Active Exception Status bit7 (Reserved/Always 0)
177	CL_NC_MFC_Sts.nStsSummary	0(LSB)	Device Fault	1: Error (error, failure, etc.)
178		1	Service in Progress	SEC-N117 0x600F:01 Status / 1: Command object is being executed
179		2	Invalid Data Input	SEC-N117 0x600F:02 Status / 1: Invalid data set in RxPDO
180		3	Ramp Active	SEC-N117 0x600F:03 Status / 1: Ramp is being executed
181		4	Valve Control Mode (fully-open)	SEC-N117 0x600F:04 Status / 1: Fully open
182		5	Valve Control Mode (fully-closed)	SEC-N117 0x600F:05 Status / 1: Fully closed
183		6	Valve Control Mode (position control)	SEC-N117 0x600F:06 Status / 1: Valve drive voltage under direct control
184		7	Communication Error	1: Communication error
185		8	Active Device Warning	SEC-N117 0xF380:00 Active Exception Status bit0
186		9	Active Manufacturer Warning	SEC-N117 0xF380:00 Active Exception Status bit1
187		10	Active Device Error	SEC-N117 0xF380:00 Active Exception Status bit2
188		11	Active Manufacturer Error	SEC-N117 0xF380:00 Active Exception Status bit3
189		12	(Reserved)	SEC-N117 0xF380:00 Active Exception Status bit4 (Reserved/Always 0)
190		13	(Reserved)	SEC-N117 0xF380:00 Active Exception Status bit5 (Reserved/Always 0)
191		14	(Reserved)	SEC-N117 0xF380:00 Active Exception Status bit6 (Reserved/Always 0)
192		15	(Reserved)	SEC-N117 0xF380:00 Active Exception Status bit7 (Reserved/Always 0)

#	Variable	Bit	Description	Note
193	CL_HE_MFC_Sts.nStsSummary	0(LSB)	Device Fault	1: Error (error, failure, etc.)
194		1	Service in Progress	SEC-N117 0x600F:01 Status / 1: Command object is being executed
195		2	Invalid Data Input	SEC-N117 0x600F:02 Status / 1: Invalid data set in RxPDO
196		3	Ramp Active	SEC-N117 0x600F:03 Status / 1: Ramp is being executed
197		4	Valve Control Mode (fully-open)	SEC-N117 0x600F:04 Status / 1: Fully open
198		5	Valve Control Mode (fully-closed)	SEC-N117 0x600F:05 Status / 1: Fully closed
199		6	Valve Control Mode (position control)	SEC-N117 0x600F:06 Status / 1: Valve drive voltage under direct control
200		7	Communication Error	1: Communication error
201		8	Active Device Warning	SEC-N117 0xF380:00 Active Exception Status bit0
202		9	Active Manufacturer Warning	SEC-N117 0xF380:00 Active Exception Status bit1
203		10	Active Device Error	SEC-N117 0xF380:00 Active Exception Status bit2
204		11	Active Manufacturer Error	SEC-N117 0xF380:00 Active Exception Status bit3
205		12	(Reserved)	SEC-N117 0xF380:00 Active Exception Status bit4 (Reserved/Always 0)
206		13	(Reserved)	SEC-N117 0xF380:00 Active Exception Status bit5 (Reserved/Always 0)
207		14	(Reserved)	SEC-N117 0xF380:00 Active Exception Status bit6 (Reserved/Always 0)
208		15	(Reserved)	SEC-N117 0xF380:00 Active Exception Status bit7 (Reserved/Always 0)
209	CM_TH_sSts.nStsSummary	0(LSB)	Device Fault	1: Error (error, failure, etc.)
210		1	(Reserved)	
211		2	(Reserved)	
212		3	(Reserved)	
213		4	(Reserved)	
214		5	(Reserved)	
215		6	(Reserved)	
216		7	Communication Error	1: Communication error
217		8	(Reserved)	
218		9	(Reserved)	
219		10	(Reserved)	
220		11	(Reserved)	
221		12	(Reserved)	
222		13	(Reserved)	
223		14	(Reserved)	
224		15	(Reserved)	

Technical Specification of PBS.55.C6 PoPola Alcohol Gas Supply System

ITER Project Japan Domestic Agency

	Name	Affiliation	Date	Signature
Author	IMAZAWA Ryota (TRO)	Plasma Diagnostics Group	26-April-2023	今澤 良太
Co-author	MUKAI Tomoya	Plasma Diagnostics Group	26-April-2023	向井 智也
Reviewers	KITAZAWA Sin-iti	Plasma Diagnostics Group	27-April-2023	北澤 真一
Reviewers	HATAE Takaki	Dept. of ITER Project	28-April-2023	渡多江 仰紀
Approver	NUNOYA Yoshihiko (RPGL)	Plasma Diagnostics Group	28-April-2023	沼野 嘉彦

Change log

Branch no. (date) (IDM number)	Change description
- (1-April-2023) (not in IDM)	First version (in Japanese)
1 (26-April-2023) (9EBQLD v1.0)	This document was translated from Japanese into English.

Table of Contents

1	PURPOSE.....	4
2	SCOPE.....	4
3	DEFINITIONS.....	4
4	OVERVIEW.....	5
5	TECHNICAL SPECIFICATIONS AND REQUIREMENTS.....	7
5.1	TECHNICAL SPECIFICATIONS FOR STRUCTURE.....	7
5.2	TECHNICAL SPECIFICATIONS FOR SIGNALS OF REMOTE CONTROL	9
5.3	TECHNICAL SPECIFICATIONS FOR HEATING	11
5.4	TECHNICAL SPECIFICATIONS FOR ABNORMAL DETECTION	12
5.5	MISCELLANEOUS SPECIFICATIONS FOR ALCOHOL GAS SUPPLY SYSTEM.....	13

1 Purpose

ITER Poloidal Polarimeter (PoPola, PBS.55.C6) injects a linearly polarized FIR laser beam into a plasma and determines the current profile inside the plasma from the measurement of polarization state change generated in the plasma. The FIR laser is a molecular gas laser using alcohol gas (methanol CH_3OH gas) as a medium and oscillates at a wavelength of 119 μm . "Alcohol Gas Supply System" in the scope of this document is a device to supply alcohol gas that is required to operate the FIR laser. When JADA developed a prototype of the FIR laser, JADA used a custom-made device called a liquid source controller (HORIBA, Model number: LSC-7900-00004) as the alcohol gas supply system. This HORIBA liquid source controller has two alcohol gas supply lines, while ITER requires six gas supply lines. Instead of using three HORIBA liquid source controllers, a new alcohol gas supply system will be manufactured for PoPola. This document gives the technical specification of the new alcohol gas supply system for PoPola.

This document will be used not only as a design input for the fabrication of the Alcohol Gas Supply System, but also as an input for the I&C design of PoPola.

2 Scope

This document provides the technical specifications of Alcohol Gas Supply System, and the design specifications are beyond the scope of this document.

Note: The alcohol gas supply system is an ITER Quality Classification Class 3 component, and safety classification is NSR, so no design review is required (See "Quality Classification Determination" (ITER_D_24VQES v5.2)). Therefore, JADA will clarify its specifications for this system by FDR of PoPola but will not provide the detailed design of this system before the FDR. The detailed design will be carried out by a supplier that JADA will contract with to manufacture the alcohol gas supply in the future. Similarly, JADA will not provide the design specifications (or product specifications)¹ and data sheets (or specification sheets)² of the alcohol gas supply system by FDR. They will be delivered to the ITER Organization together with the product after its fabrication.

3 Definitions

AV	Actuated Valve
CA	Channel Access
EPICS	Experimental Physics & Industrial Control System
FC	Fast Controller
FIR	Far Infra-Red
I&C	Instrumentation and Control
MCR	Main Control Room
MFC	Mass Flow Controller
OPC UA	OPC Unified Architecture

¹ A design specification (or product specification) is a document that specifies how technical specifications are to be implemented.

² A data sheet (or specification sheet) is a document that describes the performance and characteristics of the manufactured equipment.

PoPola	Poloidal Polarimeter
PV	Process Variable
PSH	Plant System Host

For a complete list of ITER abbreviations see: [ITER_D_2MU6W5 - ITER Abbreviations](#)

4 Overview

This section describes how the Alcohol Gas Supply System will be used in ITER.

Gas Flow

PoPola will use three FIR lasers. A single alcohol gas supply system will supply alcohol gas for three of these FIR lasers. Figure 1 shows a diagram of the alcohol gas flow. The alcohol gas supply system includes a tank of liquid alcohol, which is branched to supply alcohol gas to the three FIR lasers. The detailed structure is given by Section 5.1.

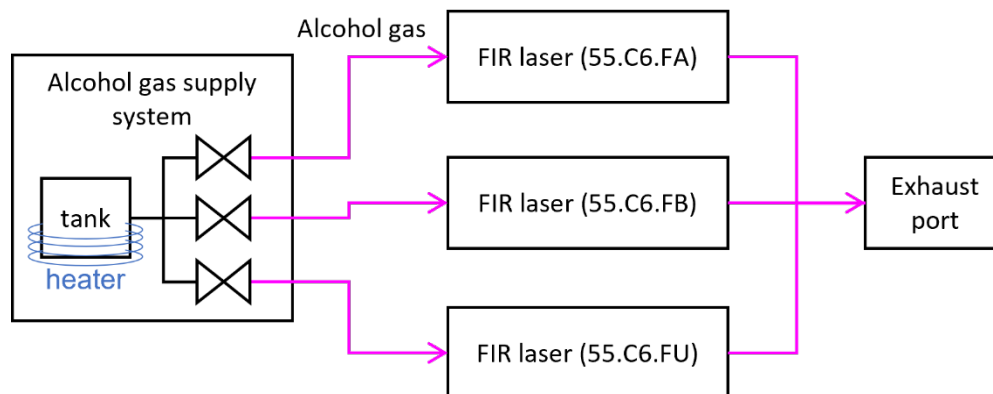


Figure 1 Alcohol gas flow diagram (top level)

Control Structure

The Alcohol Gas Supply System has multiple valves and multiple mass flow controllers (MFCs) dedicated to each FIR laser in order to supply alcohol gas separately. On the other hand, the heater for vaporizing alcohol and the component for checking the remaining amount of alcohol are component shared by the three FIR lasers. Therefore, the component dedicated to each FIR laser will be controlled by a PLC embedded in each laser system, and the component shared by the three FIR lasers will be controlled by a supervisory PLC that monitors the entire PoPola system. The supervisory PLC is called “PLC for Monitoring”. Figure 2 shows a diagram of control signals. The blue lines in the figure are the signal lines dedicated to each FIR laser, and the black line are the signal line of the component shared by the three FIR lasers. The detailed information on the signals is given by Section 5.2.

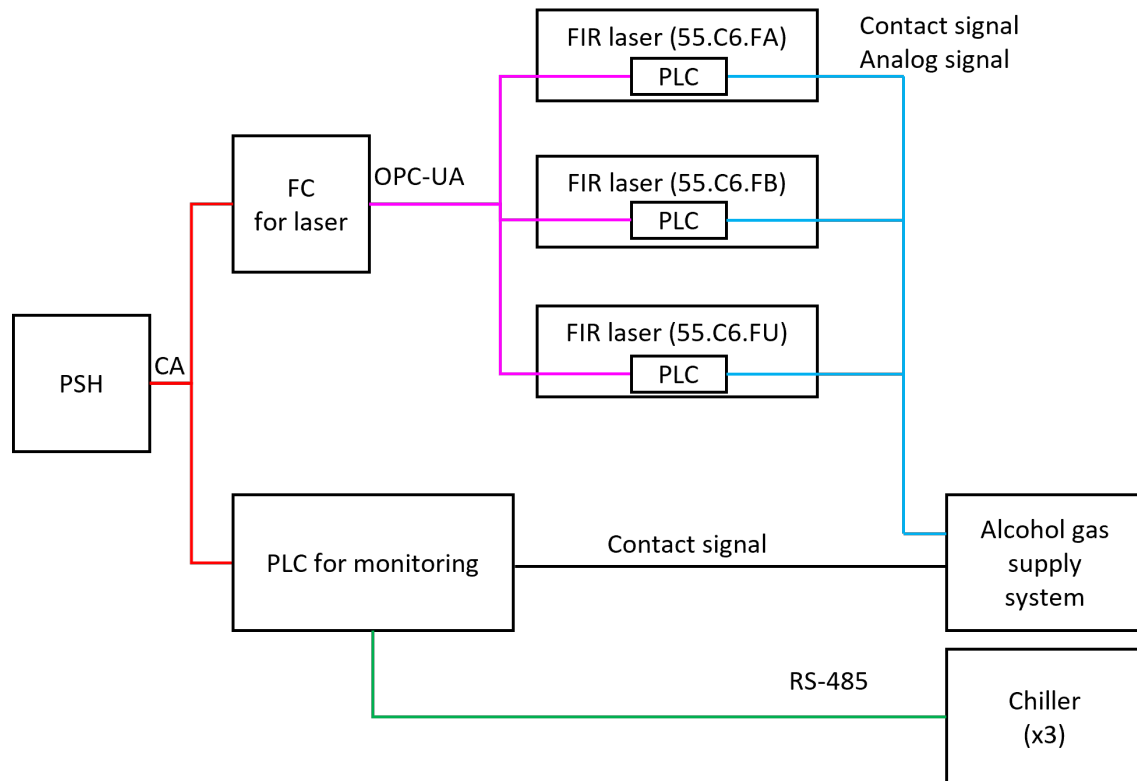


Figure 2 Control signal system diagram

Flow of Control Signal

The following describes the flow of signals sent from the upper system to the Alcohol Gas Supply System.

First, the component dedicated to each FIR laser is described. For example, assume a case where OPEN/CLOSE command is sent to a valve in a pipe line supplying alcohol gas to 55.C6.FA FIR laser. When a user clicks on OPEN/CLOSE button of the valve in the GUI of the MCR of ITER, the PV values related to the opening and closing of the valve managed by the PC controlling the FIR laser (FC for laser in Figure 2) are updated via the PSH. This communication is performed by the EPICS CA. Next, the variables related to the opening and closing of the valves managed by the PLC embedded in the 55.C6.FA FIR laser are updated. Finally, the PLC sends a contact signal to the alcohol gas supply unit, which opens and closes the valve.

Second, the following describes the signal flow to the equipment shared by the three FIR lasers. For example, assume a case in which ON/OFF command is sent to a heater for vaporizing alcohol. When the ON/OFF button for the heater is clicked in the GUI of the MCR, the PV value for ON/OFF of the heater managed by the PLC for Monitoring is updated via PSH. This communication is performed by the EPICS CA. Next, a contact signal is sent from PLC for Monitoring to the Alcohol Gas Supply System to perform the ON/OFF operation of the heater.

5 Technical Specifications and Requirements

5.1 Technical specifications for structure

Table 1 and Figure 3 describe the specifications for the structure of the Alcohol Gas Supply System. In these charts, you find “AV” and 3-way solenoid valves. AV refers to the pneumatic actuated valve. Although the 3-way solenoid valves in Figure 3 are not connected to the AVs visibly, the 3-way solenoid valves are connected to AVs.

Table 1 Specifications for the structure of the Alcohol Gas Supply System

No.	Specification
1	One tank (content 10L) is installed to storage liquid alcohol.
2	One liquid level gauge is installed to determine the amount of liquid alcohol remaining in the tank.
3	The tanks and piping are heated with electric heaters to prevent the alcohol gas from liquefying on the pipe walls, etc. (See section 5.3).
4	The main valve (AV-1) is installed (See Figure 3). <u>Supplementary information:</u> AV-1 is opened when alcohol gas is supplied to the FIR laser and when it is purged.
5	The purge valve (AV-2) is installed for purging (See Figure 3). When this valve opens, the valves AV3 to AV8 close automatically. The connection between the external compressed air piping for purging and this equipment shall be a 1/4-inch VCR female connector. <u>Supplementary information:</u> Open AV-2 only when purging lines. When purging lines, open AV-1, AV-2, and the bleed valve to supply compressed air.
6	The refill valve and the bleed valve are installed to refill the liquid alcohol into the tank (See Figure 3). The connection between the external piping and the alcohol supply port of this system is a 1/4-inch VCR female connector. <u>Supplementary information:</u> The refill valve and the bleed valve are manually operated. The valves are always closed except when liquid alcohol is refilled. When liquid alcohol is refilled, both the refill valve and the bleed valve are open. Liquid alcohol is poured into the tank through the piping connected to the refill valve. The air in the tank then escapes through the piping connected to the bleed valve.
7	Six independent alcohol gas supply lines are installed. Each line has a pressure valve and a MFC (AV-3 to AV-8 and MFC-1 to MFC-6 in Figure 3). The connection between the external alcohol gas piping and this component is a 1/4-inch VCR female connector. <u>Supplementary Information:</u> This system is intended to supply alcohol gas to three FIR lasers. Each laser requires two gas lines; one for the FIR laser cavity and one for the Stark cell. Thus, a total of six gas lines are required from this system.
8	For MFC-1 to MFC-6, HORIBA's SEC-8440F CH ₃ OH 10 sccm or equivalent will be used. <u>Supplementary information:</u> This MFC has a maximum flow rate (F.S.) of 10 sccm, a flow rate accuracy of +/- 2% F.S., and a flow control range of 2% to F.S.
9	The system can switch between local and remote control, and an LCD touch panel is installed for local control. In addition, electrical terminals are installed to input and output signals for remote control (See section 5.2).

- | | |
|----|---|
| 10 | <p>The enclosure of the system is a single component, installed with casters for mobility, level feet and anti-tipping brackets.</p> <p><u>Reference information:</u> HORIBA's Liquid Source Controller (Model number: LSC-7900-00004) (See Section 1) is separated into two enclosures, the lower air section and the controller section, but its structure shall not be followed.</p> |
|----|---|

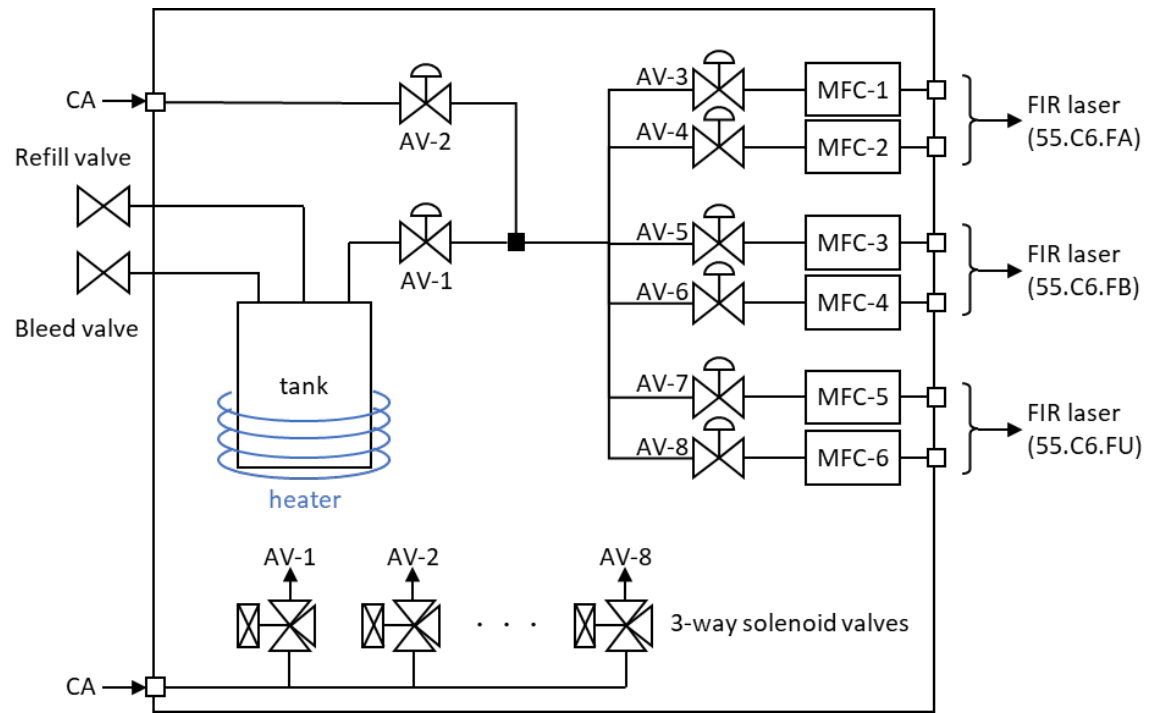


Figure 3 Structure of Alcohol Gas Supply System

5.2 Technical specifications for signals of remote control

Remote control of the Alcohol Gas Supply System is controlled using the signals listed in Table 2. There are no specific requirements for the physical interface of the signals.

Table 2 Signal list

No.	Signal Name	Description						
1	AV-# OPEN (#: 1~8)	Direction: Input Signal type: Contact Logic: <table border="1"> <tr> <td>Signal</td><td>Open</td><td>Close</td></tr> <tr> <td>Valve</td><td>Open</td><td>Close</td></tr> </table> Note : AV-# is OPEN when inputting it at the time of remote control.	Signal	Open	Close	Valve	Open	Close
Signal	Open	Close						
Valve	Open	Close						
2	MFC-# Set Value (1~6)	Direction: Input Signal Type: DC 0~5V Note: Set the flow rate for MFC-#. 0 to 5V linearly corresponds to flow rate 0 to 100% F.S.						
3	MFC-# Process Value (1~6)	Direction: Output Signal Type: DC 0~5V Note: Output the flow rate for MFC-#. 0 to 5V linearly corresponds to flow rate 0 to 100% F.S.						
4	HEAT POWER	Direction: Input Signal Type: Contact Logic: <table border="1"> <tr> <td>Signal</td><td>Open</td><td>Close</td></tr> <tr> <td>Heater</td><td>OFF</td><td>ON (Heating)</td></tr> </table> Note: The heater is heated when inputting it at the time of remote control.	Signal	Open	Close	Heater	OFF	ON (Heating)
Signal	Open	Close						
Heater	OFF	ON (Heating)						
5	External Alarm Input	Direction: Input Signal Type: Contact Logic: <table border="1"> <tr> <td>Signal</td><td>Open</td><td>Close</td></tr> <tr> <td>Alarm</td><td>No</td><td>Yes</td></tr> </table> Note: An interlock is applied when an external alarm signal is input.	Signal	Open	Close	Alarm	No	Yes
Signal	Open	Close						
Alarm	No	Yes						

No.	Signal Name	Description						
6	External Alarm Output	Direction: Output Signal Type: Contact Logic: <table border="1"> <tr> <td>Signal</td><td>Open</td><td>Close</td></tr> <tr> <td>Alarm</td><td>No</td><td>Yes</td></tr> </table> Note: Output in case of alarm (when interlock is applied)	Signal	Open	Close	Alarm	No	Yes
Signal	Open	Close						
Alarm	No	Yes						
7	Alarm Reset	Direction: Input Signal Type: Contact Logic: <table border="1"> <tr> <td>Signal</td><td>Open</td><td>Close</td></tr> <tr> <td>Alarm</td><td>No change</td><td>Reset</td></tr> </table> Note: When an alarm is triggered, an interlock is applied. This signal is used to remotely disable the interlock.	Signal	Open	Close	Alarm	No change	Reset
Signal	Open	Close						
Alarm	No change	Reset						
8	Local/Remote Switching	Direction: Input Signal Type: Contact Logic: <table border="1"> <tr> <td>Signal</td><td>Open</td><td>Close</td></tr> <tr> <td>Alarm</td><td>Local</td><td>Remote</td></tr> </table> Note: This signal is used to switch between local and remote control.	Signal	Open	Close	Alarm	Local	Remote
Signal	Open	Close						
Alarm	Local	Remote						
9	Alcohol Level	Direction: Output Signal Type: DC 0~5V Note: Outputs the amount of alcohol remaining. 0 to 5V linearly corresponds to liquid volume 0 to 100% F.S.						

5.3 Technical specifications for heating

The inside of the Alcohol Gas Supply System is heated from the tank to the exhaust port to prevent liquefaction of alcohol gas at the pipe walls. The internal temperature is not uniform, but the temperature is higher from the tank to the exhaust port. The temperature is divided into five zones as shown in Figure 4. A temperature controller (PID controller) is embedded in Alcohol Gas Supply System so that the temperature of each zone can be adjusted independently. The temperature, PID control parameters, and temperature rise time are not set by remote control, but are set on the display panel of the Alcohol Gas Supply System.

For reference, temperature distribution in the FIR laser prototype is as follows; $T_0=21$ degrees Celsius, $T_1=27$ degrees Celsius, and $T_2=T_3=T_4=35$ degrees Celsius.

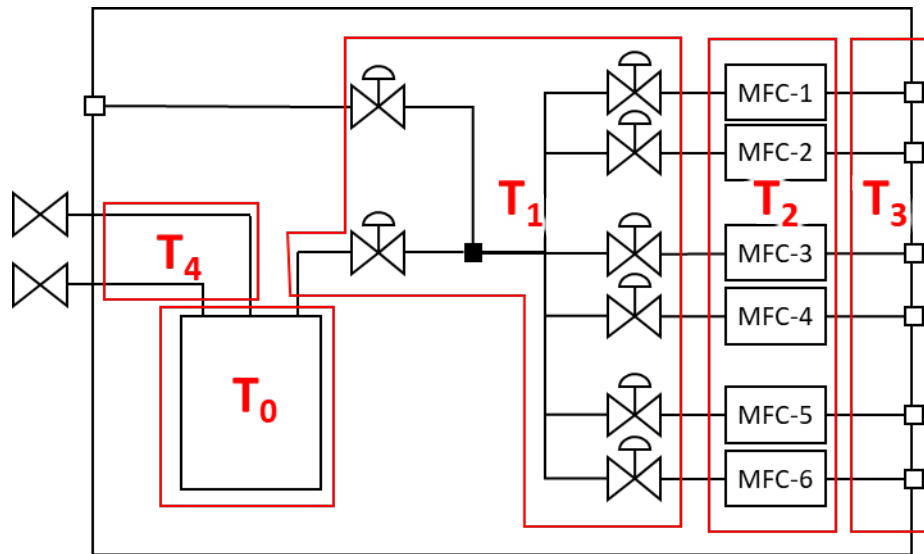


Figure 4 Temperature zoning inside the alcohol gas supply system

5.4 Technical specifications for abnormal detection

The events related to the abnormal detection and the specifications for the operation of the device are shown in Table 3. To release the interlock, an operator needs to press the reset button on the display panel of the Alcohol Gas Supply System or to close the terminal Alarm Reset.

Table 3 Abnormal state list

No.	Abnormal Condition	Event	Operation in case of anomaly	Release method
1	Temperature anomaly	When the temperature controller of the heater outputs a temperature error* ¹ .	-All valves: Closed -Heater: Shut down -Power supply: Startup state -MFC: Control state -Buzzer: Sounding	When the reset button is pressed on the display panel or the terminal Alarm Reset is closed, the abnormal state is canceled.
2	External alarm input	When the contact signal of the external alarm input turns to Close.	Same as above	When the reset button is pressed on the display panel or the terminal Alarm Reset is closed, the anomaly state is canceled. However, if the terminal External Alarm Input is still closed, the abnormal state will immediately reappear even if the abnormal state is canceled.
3	Abnormal tank level drop	When the alcohol level in the tank drops below a specified level* ² .	-All valves: No change -Heater: No change -Power supply: Startup state -MFC: Control state -Buzzer: Sounding	After the tank is refilled with alcohol, an operator will press the reset button on the display panel or close the terminal Alarm Reset, and then the abnormal state will be canceled.
4	Abnormal MFC flow rate	When the MFC controller* ³ outputs an alarm.	-All valves: No change -Heater: No change -Power supply: Startup state -MFC: Control state -Buzzer: No sound	After the cause of the MFC anomaly is resolved, an operator will press the reset button on the display panel or close the terminal Alarm Reset, and then the abnormal state will be canceled.

*¹ If the temperature deviated from the "set temperature -5 degrees Celsius" to "set temperature +10 degrees Celsius" within 2 hours, the temperature was judged to be an anomaly.

*² In the FIR laser prototype, an alarm was triggered when the liquid volume dropped below 300 cc.

*³ In the FIR laser prototype, a HORIBA PE-D20 was used as the MFC control unit. An alarm is output if the flow rate deviates from the set value +/-3 %.

*⁴ Adjustment of secondary side pressure, etc.

5.5 Miscellaneous specifications for alcohol gas supply system

The alcohol gas supply system must comply with the following specifications:

1. The power supply for this system shall be a universal power supply, so that this system can be used in both Japan (100 VAC single-phase 50/60 Hz) and France (230 VAC single-phase 50 Hz)
2. This system must comply with European regulations and directives (note that this equipment handles low voltage, compressed air, and toxic gas (methanol))
3. This system shall be able to operate in the ITER diagnostics room environment (temperature: 22 +/-5 degrees Celsius, humidity: 55% or less).

Technical Description of PBS.55.C6 THz Detector and Cryocooler

ITER Project Japan Domestic Agency

	Name	Affiliation	Date	Signature
Author	IMAZAWA Ryota (TRO)	Plasma Diagnostics Group	14-Jun-2023	今澤 良太
Co-author	MUKAI Tomoya	Plasma Diagnostics Group	14-Jun-2023	向井 智也
Reviewers	HASHIMOTO Yasunori	Plasma Diagnostics Group	20-Jun-2023	橋本 慰登
Reviewers	HATAE Takaki	Dept. of ITER Project	20-Jun-2023	渡辺 江 仰 紀
Approver	NUNOYA Yoshihiko (RPGL)	Plasma Diagnostics Group	22-Jun-2023	沼田 嘉彦

Change log

Brunch no. (date) (IDM number)	Change description
- (22-Jun-2023) (9H7JPS v1.0)	First version
	—

Table of Contents

1. PURPOSE	4
2. SCOPE	4
3. DEFINITIONS	4
4. OVERVIEW	5
4.1. ROTATING WAVEPLATE STOKES POLARIMETER	5
4.2. OPERATION PLAN.....	5
4.3. CONTROL OF THZ DETECTOR AND CRYOCOOLER.....	5
5. TECHNICAL DESCRIPTION OF THZ DETECTOR.....	6
6. TECHNICAL DESCRIPTION OF CRYOCOOLER.....	7
6.1. OUTLINE	7
6.1.1. Hardware Architecture of cryocooler (PT405-RM + CPA2850)	7
6.1.2. Front panel of the CPA2850.....	8
6.1.3. Control panel of the CPA2850.....	10
6.2. OPERATION PROCEDURE OF CRYOCOOLER	12
6.2.1. Startup and shutdown procedures	12
6.2.2. Recommended routine procedures.....	12
6.3. TECHNICAL SPECIFICATIONS OF CRYOCOOLER	14
6.3.1. Overall specifications	14
6.3.2. Cooling water specifications.....	15
6.3.3. Electrical specifications.....	16
6.3.4. Operating parameters	16
6.4. TECHNICAL SPECIFICATIONS OF I/O SIGNALS OF CRYOCOOLER.....	17
6.5. ROUTINE MAINTENANCE OF CRYOCOOLER.....	21
6.5.1. Maintenance schedule.....	21
6.5.2. Replace the adsorber	21
6.5.3. Vent excess helium.....	22
6.5.4. Recharge helium	23
6.6. ALARM TRIP POINT	26

1. Purpose

ITER Poloidal Polarimeter (PoPola, PBS.55.C6) injects a linearly polarized FIR laser beam into a plasma and determines the current profile inside the plasma from the measurement of polarization state change generated in the plasma. The FIR laser is detected using a THz Detector (Model: QNbB/X, Maker: QMC¹) cooled to 4.4 K by a cryocooler (Model: PT405RM - CPA2850, Maker: Cryomech²). This document provides information about the THz detector and the cryocooler.

2. Scope

This document covers the following system and subsystems:

- PoPola (PBS.55.C6)

The scope of this document is only the technical descriptions of the THz detector and the cryocooler.

3. Definitions

CA	Channel Access
EPICS	Experimental Physics & Industrial Control System
FC	Fast Controller
FIR	Far Infra-Red
I&C	Instrumentation and Control
MCR	Main Control Room
MTCA	Micro Telecommunications Computing Architecture
PoPola	Poloidal Polarimeter
PV	Process Variable
RWP	Rotating Waveplate Stokes Polarimeter

For a complete list of ITER abbreviations see: [ITER_D_2MU6W5 - ITER Abbreviations](#)

¹ <http://www.qmcinstruments.co.uk/>

² <https://www.cryomech.com/>

4. Overview

4.1. Rotating Waveplate Stokes Polarimeter

PoPola uses polarization method of rotating waveplate Stokes polarimeter (RWP). Figure 1 shows hardware of RWP. The FIR laser passes through a quarter waveplate, which is rotated by a hollow-axis air-spindle motor, and then through a linear polarizer to reach a detector cooled to 4.4 K by a cryocooler. Analyzing the intensity and phase information of specific frequency components of the detector signal leads to the polarization state of the FIR laser. The details of RWP are given in [ITER_D_RTDARJ v1.0](#).

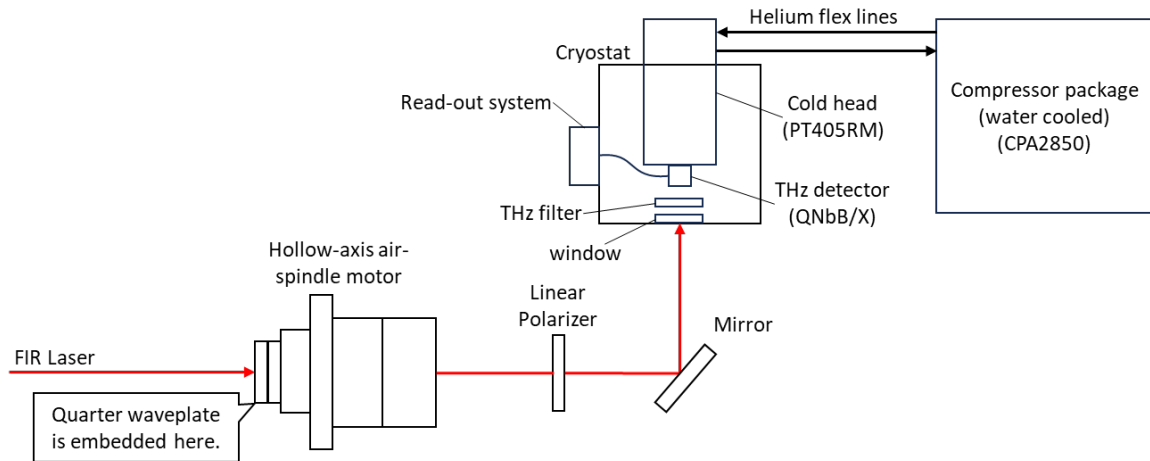


Figure 1 Hardware of RWP

4.2. Operation Plan

The THz detector needs to be cooled at 4 K to detect the FIR laser beam. Since it takes long time to cool the detector from room temperature (RT) to 4 K, the detector temperature does not return to RT during a whole plasma operation campaign.

Figure 2 shows the operational procedure of the THz detector. In LTM, the THz detector is basically at RT in LTM. Only when testing or calibrating, the THz detector is cooled at 4 K. In the states other than LTM, the THz detector is always at 4 K. In the plasma operation campaign, the global operating state repeats POS and STM/TCS in turn. The detector is kept at 4 K even during STM/TCS.

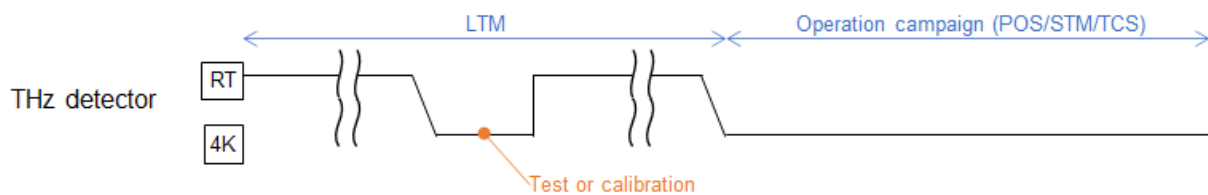


Figure 2. Diagram of operational procedure of THz detector

4.3. Control of THz Detector and Cryocooler

Since the THz detector is always at 4 K during the plasma operation campaign as explained in Section 4.2, there is no activity that Diagnostics Operator needs to do for the THz detector during the operation campaign. What Diagnostics Operator needs to do is (1) to switch on/off in LTM and (2) hands-on maintenance in LTM (Section 6.5 explains the necessary maintenance activity).

Therefore, there is no particular action that needs to be operated remotely. PoPola design team decided to operate remotely only the items below.

- (1) To start cooling.
- (2) To terminate cooling.
- (3) To monitor the status of the cryocooler.

Figure 3 shows the control signal diagram. The cryocooler is connected with PLC called “PLC for monitoring”, and EPICS IOC for the PLC runs on the plant system host (PSH). When controlling the cryocooler remotely, Diagnostics Operator uses EPICS CA. The input/output signals of the cryocooler are given in Section 6.4.

As for the THz detector, the detector signals are only sent to a processing board installed in the MTCA chassis and are not controlled remotely.

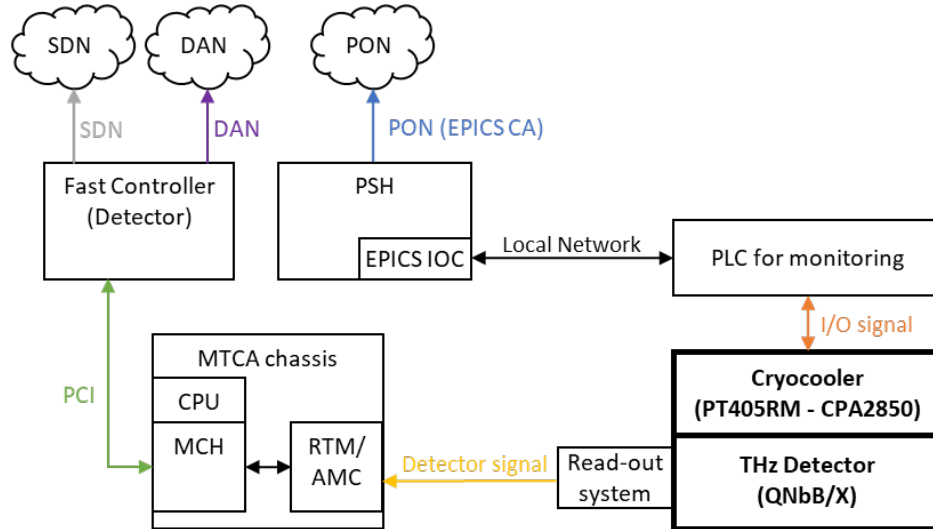


Figure 3 Control Signal System Diagram

5. Technical Description of THz Detector

THz Detector (Model: QNbB/X, Maker: QMC) is a transition edge superconducting (TES) bolometer. The operating principle relies on channeling EM radiation onto an absorber, causing its energy to be deposited as heat. This propagates through the semiconducting crystal until it reaches a superconducting ring, which is operated at a temperature where it is making the transition from the normal state to the superconducting (zero resistance) state. The resistance thus changes sharply over a very small temperature range, making it an extremely sensitive thermometer. This resistance is monitored by the read-out system, which is provided by QMC as part of the THz detector.

Technical specification of the THz detector is shown in the table below.

Table 1 Technical specifications of THz detector (Model: QNbB/X, Maker: QMC)

Parameter	Specified values
Spectral range	0.1 – 30 THz
System optical NEP	1 pW Hz ^{-1/2} (at 100 Hz)
Specific Detectivity	3.55x10 ¹¹ cmHz ^{1/2} W ⁻¹
Detector speed (-3dB)	1 kHz (filter dependent)
Responsivity	-130 kV/W (at 100 Hz)
Linear dynamic range	1 pW – 10 μW

Coherence	incoherent
Polarization	none
Operating temperature	4 K

6. Technical Description of Cryocooler

6.1. Outline

6.1.1. Hardware Architecture of cryocooler (PT405-RM + CPA2850)

Figure 4 shows the outline of the cold head (PT405-RM) and compressor package (CPA2850) that make up the cryocooler. The compressor package is cooled by water.

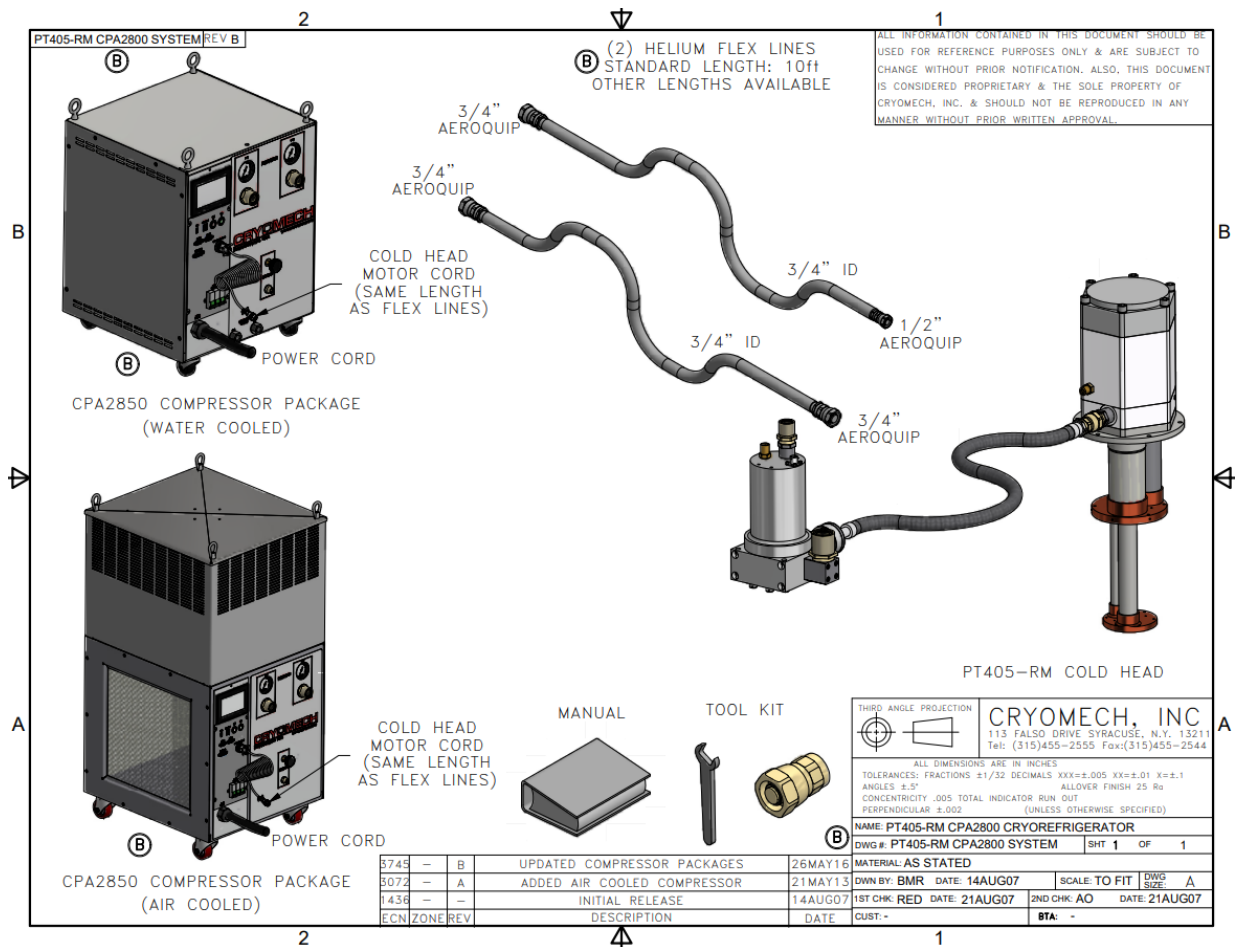


Figure 4 Hardware Architecture of cryocooler (PT405 RM + CPA2850)

6.1.2. Front panel of the CPA2850

Figure 5 shows the front panel of the CPA2850. In addition, Table 2 provides a description of each part of the front panel.

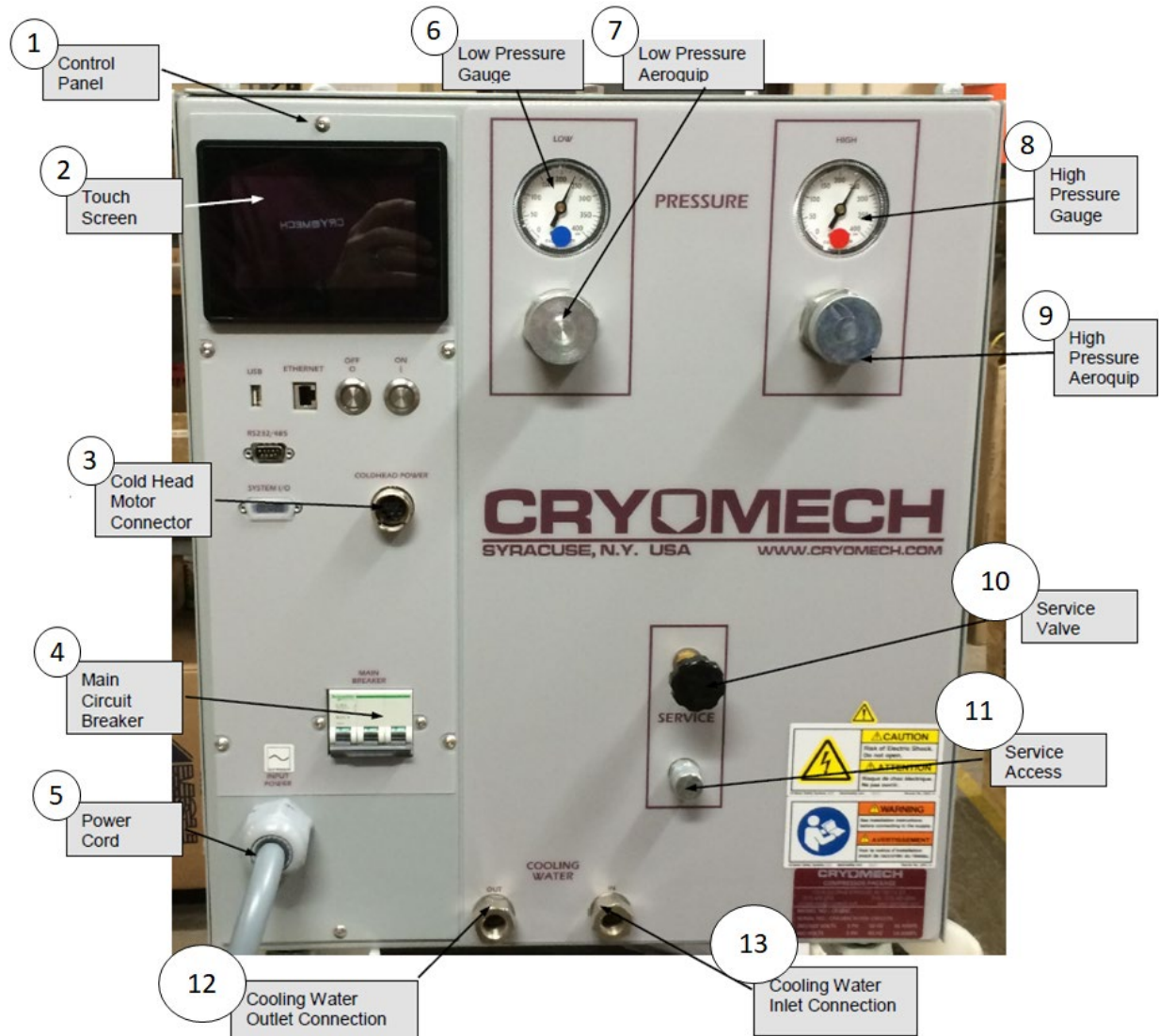


Figure 5 Front panel of the CPA2850

Table 2 Front panel of the CPA2850

No.	Part	Description
1	Control Panel	This is the control panel of the CPA2850. See section 6.1.3 for details.
2	Touch Screen	This touch panel can be used to monitor the various states of the CPA2850 and to make settings. For more information, please refer to the user manual provided by Cryomech.
3	Cold Head Motor Connector	The cold head motor cord attaches to the cold head motor connector to provide power from the CPA2850 to the cold head motor or remote motor assembly.
4	Main Circuit Breaker	The main circuit breaker provides over-current protection for the cryocooler and also functions as a main power disconnect.
5	Power Cord	The power cord supplies power from the wall to the entire system.
6	Low-Pressure Gauge	The low-pressure gauge displays the pressure of the helium gas that is being returned to the CPA2850. When the CPA2850 is off and the complete system is at room temperature, the gauge should read the pressure specified in Table 4.
7	Low-Pressure Aeroquip	The low-pressure helium flex line (not shown) fastens to the low-pressure Aeroquip that returns helium gas from the PT405-RM to the CPA2850.
8	High-Pressure Gauge	The high-pressure gauge displays the pressure of the compressed helium gas that is transported from the CPA2850. When the CPA2850 is off and the complete system is at room temperature, the gauge should read the pressure specified in Table 4.
9	High-Pressure Aeroquip	The high-pressure helium flex line (not shown) attaches to the high-pressure Aeroquip that supplies compressed helium gas from the CPA2850 to the PT405-RM.
10	Service Valve	The service valve is the valve used to regulate the amount of helium being added to or released from the system.
11	Service Access	The service access is used in conjunction with the service valve for adding helium to or releasing helium from the system.
12	Cooling Water Outlet Connection	The cooling water outlet connection carries heated water away from the CPA2850 after the water has been heated by cooling the CPA2850 during operation. The connector thread size is 3/8 FPT (3/8" Female National Pipe Thread).
13	Cooling Water Inlet Connection	The cooling water inlet connection provides water to the CPA2850 from your facility to cool the CPA2850 during operation. The connector thread size is a 3/8 FPT (3/8" Female National Pipe Thread). The water must meet the specifications provided in Section 6.3.2.

6.1.3. Control panel of the CPA2850

Figure 6Figure 5 shows the front panel of the CPA2850. In addition, Table 3 provides a description of each part of the control panel.

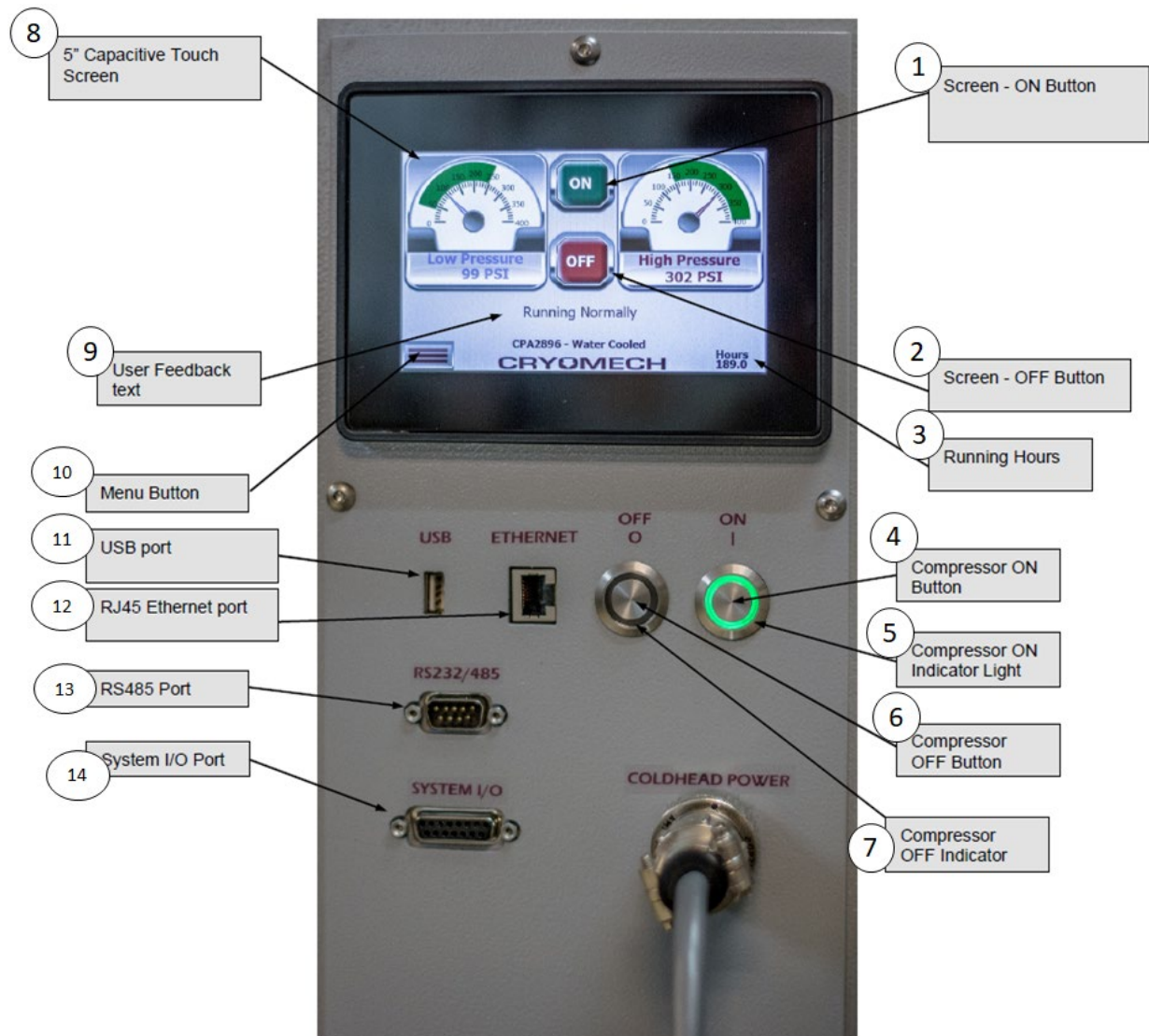


Figure 6 Control panel of the CPA2850

Table 3 Control panel of the CPA2850

No.	Part	Description
1	Screen - ON Button	The screen ON button is a digital button used to start the compressor system. Its function is the same as the compressor ON button. The button is only available on the main screen.
2	Screen OFF Button	The screen OFF button is a digital button used to stop the compressor system. Its function is the same as the compressor OFF button. The button is only available on the main screen.
3	Running hours	The running hours displays the current running(operating) hours of the compressor. (This does not include any idle or off time.)
4	Compressor ON Button	The compressor ON button is a mechanical button used to start the compressor system.
5	Compressor ON Indicator Light	The Compressor ON indicator light is illuminated when the compressor is operating.
6	Compressor OFF Button	The compressor OFF button is a mechanical switch used to stop the compressor system.
7	Compressor OFF Indicator Light	The Compressor OFF indicator light is illuminated when the compressor is switched off with the Compressor Off button or when one of the compressor's internal safety switches has tripped.
8	5" capacitive touch screen	The touch screen displays system status, warnings, error messages, and the various other operation data. It is also used to navigate through the various menus and sub screens allowing the user to access data about the compressor system.
9	User Feedback text	The user feedback text tells the operator the status of the compressor including any errors or warning which may occur.
10	Menu Button	The menu button is used to navigate the system providing additional control and monitoring.
11	USB Port	The USB Port can be used to download recorded data from the system.
12	RJ45 Ethernet Port	The RJ45 port can be used to remotely monitor and control the compressor system.
13	RS485 Port	The RS485 port can be used to remotely monitor and control the compressor system.
14	System I/O Port	The System I/O port is a DB15 female socket that can be used to remotely control the CPA2850 and monitor a limited number of its parameters. See section 6.4 for details.

6.2. Operation Procedure of Cryocooler

This chapter describes the operating procedures for the cryocooler.

6.2.1. Startup and shutdown procedures

Checks before operating

1. Check the system pressure - the gauges should read the pressure specified in Table 4.
If the pressure is too high, vent some of the helium following the instructions in Section 6.5.3.
If the pressure is too low, add helium following the instructions in Section 6.5.4.
2. Make sure the cold head motor cord is connected to both the PT405-RM and the CPA2850.
3. Make sure all Aeroquip couplings are securely fastened and the helium flex lines are oriented correctly.
4. Make sure the input power meets the specifications on the identification label.
5. Make sure the flow rate and temperature range of the cooling water meet the requirements specified in Section 6.3.2.
6. Check that the dedicated circuit breaker is on.

[CAUTION]: A voltage deviation of more than 10% above or below the voltage rating can cause compressor motor overheating and possible failure.

[CAUTION]: The PT405-RM should not be used in a magnetic field exceeding 500G.

Startup procedure

1. Switch on the circuit breaker of the CPA2850.
2. The compressor may be started by pushing the compressor ON button.

[CAUTION]: The system operates helium in a closed loop cycle at pressures higher than 200 PSIG and at temperatures below 120 Kelvin.

Shutdown procedure

Press the compressor OFF button on the front panel of the CPA2850. This will switch off the compressor system. Switch off the front-panel mounted circuit breaker to remove power from the compressor's electrical panel.

6.2.2. Recommended routine procedures

High and low pressure

Changes in the high and low-pressure readings on the CPA2850's gauges are used for diagnosing several different types of problems. It is important to know whether changes are sudden or gradual and to know how the high and low pressures are changing relative to each other. The high and low pressures should be monitored daily. It is recommended that high and low pressures be monitored daily and that readings be recorded regularly.

PT405-RM temperature

Temperature change is another important diagnostic material. If a temperature sensor is installed in the cold head heat exchanger, it is strongly recommended that the temperature be monitored daily. It is also recommended that temperatures be recorded periodically at intervals appropriate for the use of the system.

Cooling water input and output

If possible, cryocooler recommends keeping a regular record of the input and output cooling water temperatures and of the cooling water flow rate.

6.3. Technical Specifications of Cryocooler

This section describes the various specifications of the cryocooler.

6.3.1. Overall specifications

Table 4 Overall specifications

No.	Parameter	Value	Unit
1	Weight of PT405-RM	18.6	kg
2	Dimensions of PT405-RM	See Figure 7	
3	Weight of CPA2850	115	kg
4	Dimensions of CPA2850 (L x W x H)	46 * 48 * 62	cm
5	Cool down time	60	min
6	Lowest temperature	2.8 (no load)	K
7	Helium static pressure @25°C	250 +/- 5	PSIG
8	Maximum sound level	70 (at 1 meter)	dBA
9	Flexible lines length	3	m
10	Flexible lines weight	4.2	kg

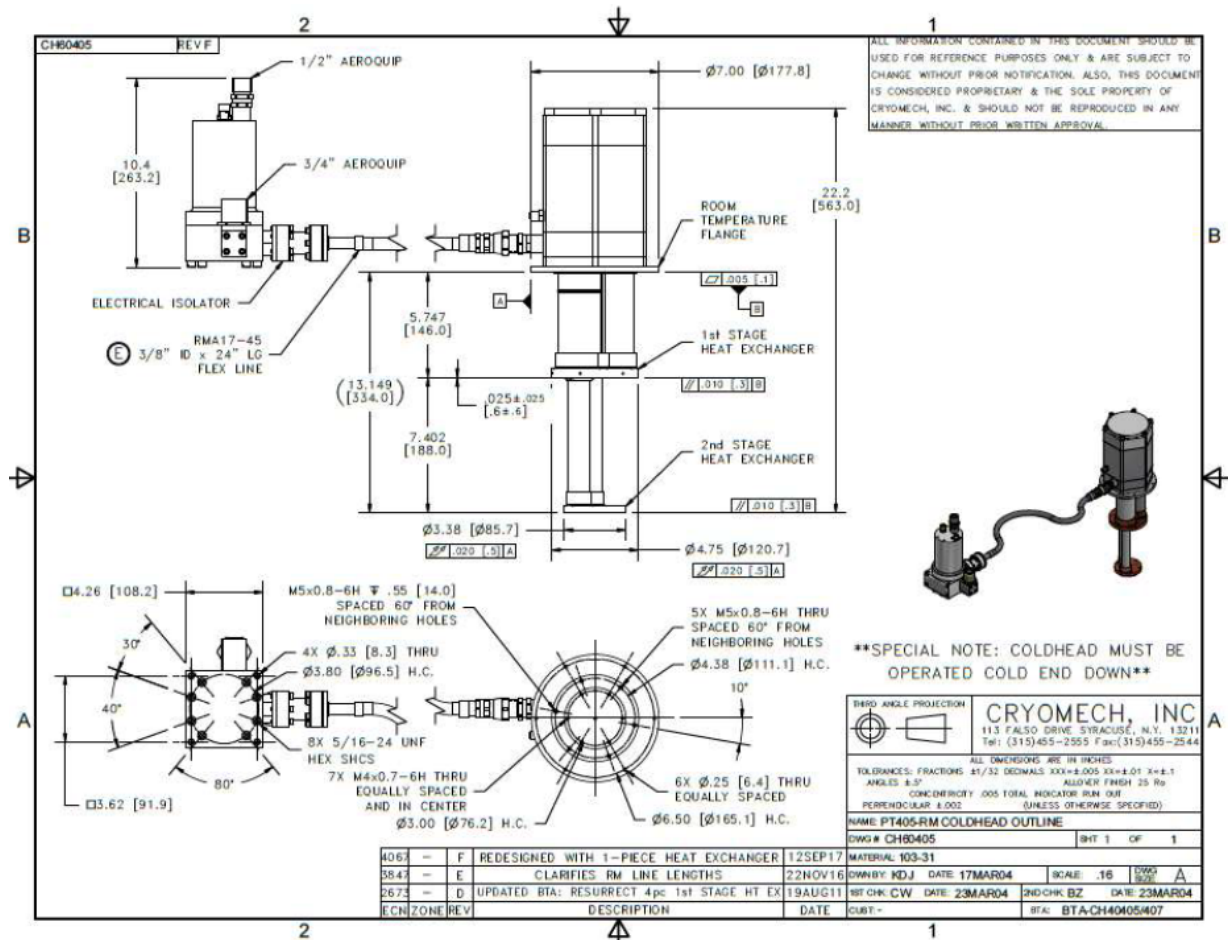


Figure 7 PT405-RM Drawing

6.3.2. Cooling water specifications

Table 5 Cooling water specifications

No.	Parameter	Value	Unit
1	Cooling water	See Figure 8 and Figure 9	-
2	Maximum inlet pressure	110	PSIG
3	Alkalinity	5.8 ~ 8.0	pH
4	Calcium carbonate	Less than 80	PPM

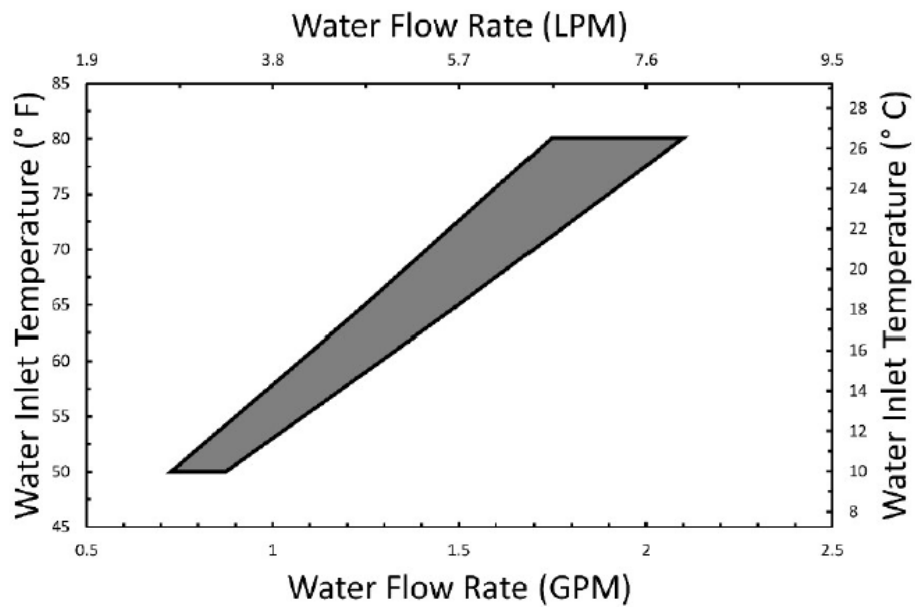


Figure 8 Cooling water flow rate

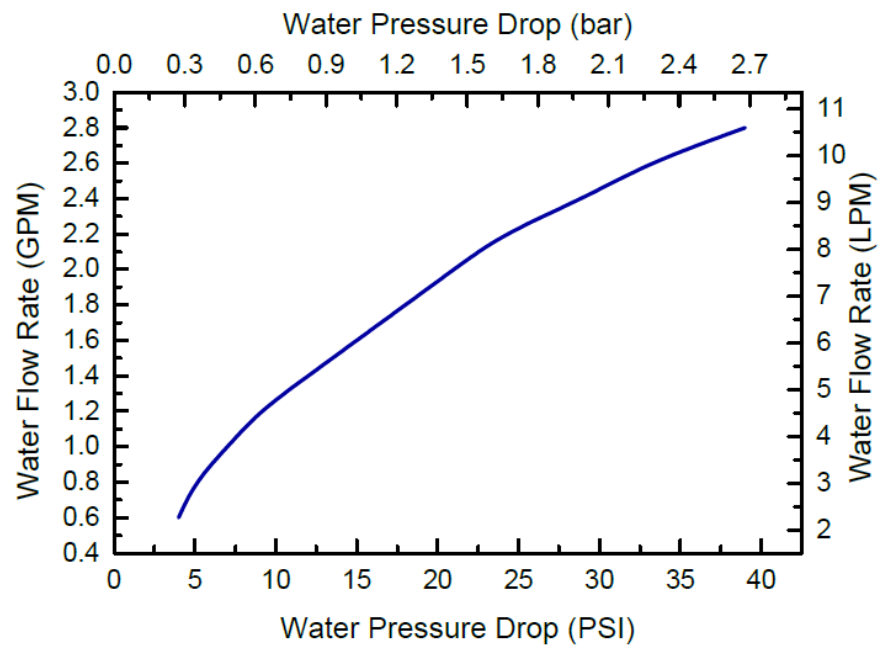


Figure 9 Cooling water pressure drop

[CAUTION]: Cooling water temperature and flow rate should fall within the shaded area of Figure 8 to maintain optimal performance. Operating outside of the shaded area may result in system entering a warning or error state.

[CAUTION]: The use of DI (De-Ionized) water is prohibited. DI water causes damage to the CPA2850.

6.3.3. Electrical specifications

Table 6 Electrical specifications (380/415 Volt, 50 Hz Model)

No.	Parameter	Value			Unit
		Min	Nominal	Max	
1	Nominal voltage	-	380/415	-	VAC
2	Operating voltage range	342	-	456	VAC
3	Frequency	-	50	-	Hz
4	Phase	-	3	-	phase
5	Mains supply voltage fluctuations	-	Up to $\pm 10\%$	-	%
6	Input power	-	4.6	5.8	kW
7	Current	-	-	10	A
8	Dedicated circuit breaker	-	25	-	A

6.3.4. Operating parameters

Table 7 Operating parameters

No.	Parameter	Value	Unit
1	Ambient temperature range* ¹	7 to 38	°C
2	System helium pressure	250 +/- 5	PSIG
3	Acceptable location	Indoors only	-
4	Maximum altitude for use	2000	M
5	Environment	Pollution Degree 2 (EN 61010)	-
6	Installation	Category II (IEC 664)	-
7	Maximum relative humidity	80% for T< 31°C Decreasing linearly to 50% at 40°C.	%
8	Maximum sound level	70 (at 1 meter)	dBA
9	Maximum load of PT405-RM	1st stage heat exchanger: 10 2nd stage heat exchanger: 5	kg

Note 1: The CPA2850 is designed to operate in an ambient temperature range from 7 to 38°C. If the temperature is below 7°C, the increased viscosity of the oil could prevent start-up and/or cause poor lubrication. Operation above 38°C will cause overheating and subsequent problems.

6.4. Technical Specifications of I/O Signals of Cryocooler

A 15-pin digital I/O connector with selected input controls and relay outputs is provided for limited monitoring and control. Figure 10 shows the pin layout.

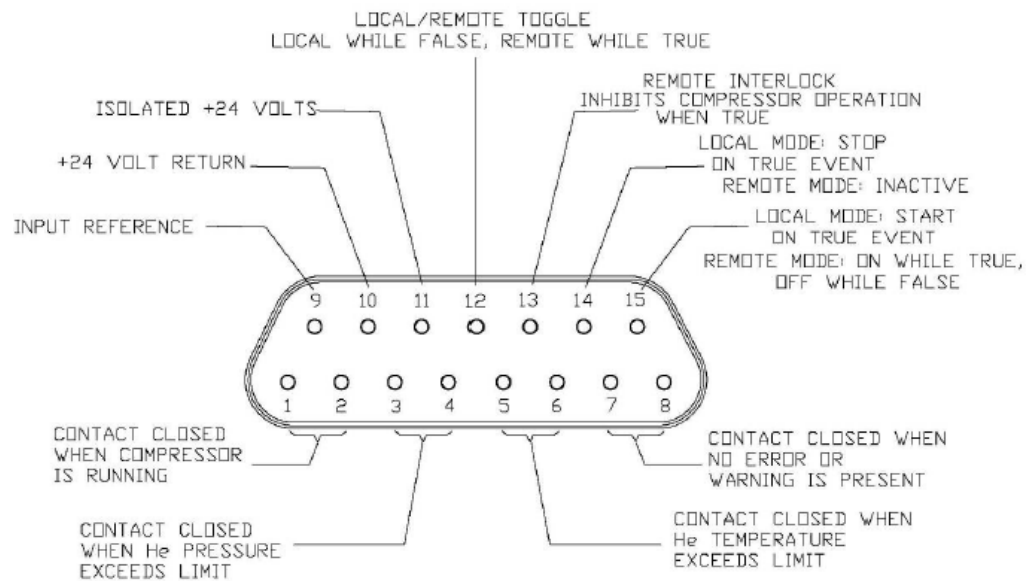


Figure 10 15 Pin connector diagram

Input signal

Three remote inputs are provided to start, stop and inhibit operation of the compressor. For INPUTS, a low or false is a voltage differential of less than 6VDC (Max1mA) between the input pin and IN_REF (pin 9). The input pin being – (neg) and the IN_RET pin being + (pos). An open circuit (no connection to the input pin) is also low (false). High or true is a voltage differential between the input pin and IN_RET that exceeds 12VDC. The input pin being – (neg) and the IN_RET pin being + (pos). Rising edge is a change in the pin state from false to true. Falling edge is a change in pin state from true to false. Again, all inputs reference to pin 9. For example, to generate a true condition on an input connect the input reference IN_REF to a positive DC voltage (greater than 12 volts and less than 30 volts (Min3mA) and close the selected input pin to the return of that supply. (An isolated 24V supply and return is provided on pins 11 and 10 of this connector respectively.) The minimum pulse width (high or low) for an input signal to be recognized is 200ms. It is possible for a signal to be recognized sooner, but due to the asynchronous nature of the design, a 200ms pulse width is necessary to guarantee the signal is recognized. Maximum input voltage without damage to the hardware is $\pm 30V$, indefinite time. Minimum guaranteed "TRUE" voltage is +12VDC. Negative voltages are considered FALSE. Input "impedance" is about 3.3K Ohm. Inputs are ESD protected. Table 8 shows all of the available input signals of the cryocooler, and PoPola system shall provide a function to control the signal "Start" in EPICS CA.

Table 8 Input signal list

Pin No.	Signal Name	Description								
12	Local/Remote (Set Value)	Direction: Input Signal type: DC 0~24V Logic: <table><tr><td>0</td><td>1</td></tr><tr><td>Local</td><td>Remote</td></tr></table> Note: Change local and remote mode. Note: PoPola does not use this signal.	0	1	Local	Remote				
0	1									
Local	Remote									
13	Interlock (Set Value)	Direction: Input Signal type: DC 0~24V Logic: <table><tr><td>0</td><td>1</td></tr><tr><td>Nothing to do</td><td>Interlock</td></tr></table> Note: Disable cryocooler operation. Note: PoPola does not use this signal.	0	1	Nothing to do	Interlock				
0	1									
Nothing to do	Interlock									
14	Stop (Set Value)	Direction: Input Signal type: DC 0~24V Logic: <u>Local Mode</u> <table><tr><td>0</td><td>1</td></tr><tr><td>Nothing to do</td><td>Stop</td></tr></table> <u>Remote Mode</u> : Inactive Note: Stop the cryocooler.	0	1	Nothing to do	Stop				
0	1									
Nothing to do	Stop									
15	Start (Set Value)	Direction: Input Signal type: DC 0~24V Logic: <u>Local Mode</u> <table><tr><td>0</td><td>1</td></tr><tr><td>Nothing to do</td><td>Start</td></tr></table> <u>Remote Mode</u> <table><tr><td>0</td><td>1</td></tr><tr><td>Stop</td><td>Start</td></tr></table> Note: Running the cryocooler.	0	1	Nothing to do	Start	0	1	Stop	Start
0	1									
Nothing to do	Start									
0	1									
Stop	Start									

Output signal

Four standard outputs are provided. They are relay closures which indicate that the compressor motor is running, the helium temperature or pressure has exceeded set limits or that no errors or warnings have been detected. All outputs are contact closures (rated at 2amps 24 VDC). Table 9 shows all of the available output signals, and PoPola system shall provide a function to monitor all signals in EPICS CA.

Table 9 Output signal list

Pin No.	Signal Name	Description						
1 and 2	Running state (Process Value)	Direction: Output Signal type: Contact Logic: <table border="1"> <tr> <td>Signal</td><td>Open</td><td>Close</td></tr> <tr> <td>State</td><td>Not Running</td><td>Running</td></tr> </table> Note: Monitor running state of cryocooler.	Signal	Open	Close	State	Not Running	Running
Signal	Open	Close						
State	Not Running	Running						
3 and 4	Pressure anomaly (Process Value)	Direction: Output Signal type: Contact Logic: <table border="1"> <tr> <td>Signal</td><td>Open</td><td>Close</td></tr> <tr> <td>Anomaly</td><td>Helium pressure anomaly</td><td>No abnormality</td></tr> </table> Note: Monitor helium pressure.	Signal	Open	Close	Anomaly	Helium pressure anomaly	No abnormality
Signal	Open	Close						
Anomaly	Helium pressure anomaly	No abnormality						
5 and 6	Temperature anomaly (Process Value)	Direction: Output Signal type: Contact Logic: <table border="1"> <tr> <td>Signal</td><td>Open</td><td>Close</td></tr> <tr> <td>Anomaly</td><td>Helium temperature anomaly</td><td>No abnormality</td></tr> </table> Note: Monitor helium temperature.	Signal	Open	Close	Anomaly	Helium temperature anomaly	No abnormality
Signal	Open	Close						
Anomaly	Helium temperature anomaly	No abnormality						
7 and 8	Any anomaly (Process Value)	Direction: Output Signal type: Contact Logic: <table border="1"> <tr> <td>Signal</td><td>Open</td><td>Close</td></tr> <tr> <td>Anomaly</td><td>Operational error in CPA2850</td><td>No abnormality</td></tr> </table> Note: Monitor all parameters in the cryocooler.	Signal	Open	Close	Anomaly	Operational error in CPA2850	No abnormality
Signal	Open	Close						
Anomaly	Operational error in CPA2850	No abnormality						

6.5. Routine Maintenance of Cryocooler

This section contains basic, essential maintenance information.

6.5.1. Maintenance schedule

Table 10 Maintenance schedule

Maintenance	Frequency	Comment
Replace cold head seals	Every 10,000 hours	Contact Cryomech
Replace cold head valve and valve plate	Every 20,000 hours	Contact Cryomech
Replace adsorber	Every 15,000 hours	See Section 6.5.2
Vent helium gas	As required	See Section 6.5.3
Charge helium gas	As required	See Section 6.5.4

6.5.2. Replace the adsorber

Table 11 Required tools

Tool	Quantity	Comment
1" Open end wrench	1	For Aeroquip coupling
1-1/8" Open end wrench	1	For Aeroquip coupling
1-3/16" Open end wrench	1	For Aeroquip coupling
Slotted screwdriver	1	For hose clamps
Phillips head screwdriver	1	For side panel fasteners

1. Shut down the system by pressing the OFF button, then turn off the circuit breaker of CPA2850 and disconnect the input power of CPA2850.
2. Disconnect both helium flex lines from the compressor.
3. Remove the cover from the CPA2850.
 - (a). Remove the screws rivets that hold on the right-side cover.
 - (b). Pull the panel away from the CPA2850.
4. Using three wrenches disconnect the Aeroquip coupling between the adsorber and the oil separator as shown in Figure 11.

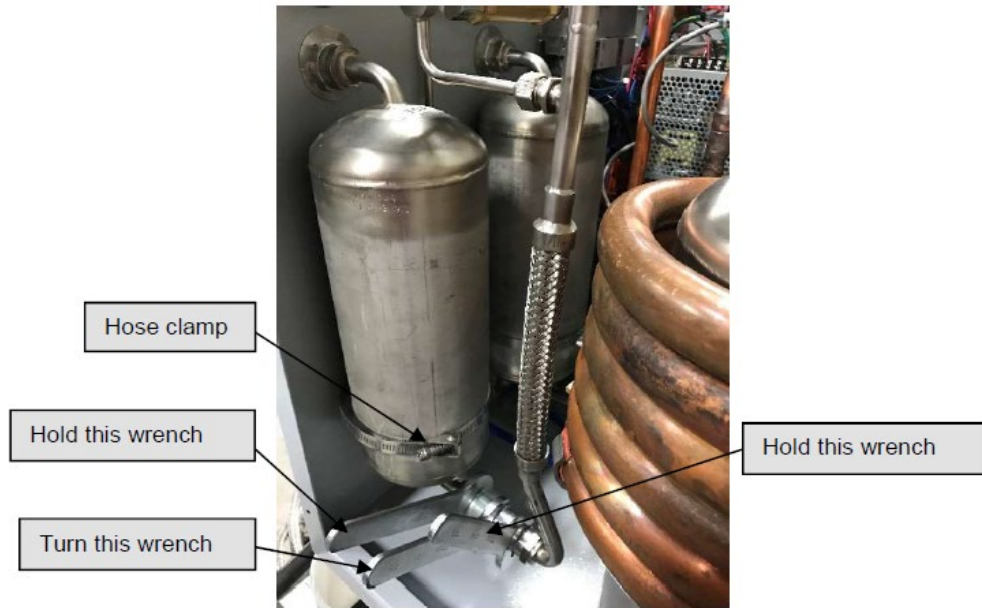


Figure 11 Disconnecting the Aeroquip adsorber

5. Remove the nut holding the high-pressure Aeroquip coupling to the front panel.
6. Loosen and disconnect the hose clamp that attaches the adsorber to the front panel.
7. Remove the adsorber from the CPA2850.
8. Check the Aeroquip couplings for oil residue.
9. To install the new adsorber, reverse steps three through seven.
10. Reconnect both helium flex lines to the compressor.
11. Reattach the cover or side panel to the CPA2850.

[WARNING]: Before removing the CPA2850 panel, input power must be disconnected from the CPA2850.

[CAUTION]: At no time, should the Aeroquip couplings be removed from the adsorber when replacing the adsorber. Replacement can be completed without relieving system pressure since the adsorber is equipped with Aeroquip couplings for sealed removal.

6.5.3. Vent excess helium

Table 12 Required tools

Tool	Quantity	Comment
3/4" Open end wrench	1	For Aeroquip coupling
Service Aeroquip coupling	1	For service access port

This procedure should only be used to vent small quantities of helium from an overcharged system.

1. Make sure the service valve is closed. See Figure 8-2.
2. Attach the small service Aeroquip coupling to the service access port.
3. Open the service valve slowly. Do not vent more than 5 PSIG (.34 bar / 34 kilopascal) of helium per minute.

4. After venting the helium, close the service valve and remove the service Aeroquip from the service access port.

[CAUTION]: Venting more than 5 PSIG (.34 bar / 34 kilopascal) of helium per minute will lead to improper oil migration within the system.

6.5.4. Recharge helium

Table 13 Required tools

Tool	Quantity	Comment
3/4" Open end wrench	1	For Aeroquip coupling
Service Aeroquip coupling	1	For service access port
Vacuum/charging station	1	For adding helium

This procedure must be performed with the CPA2850 stopped. Helium can be added even when the PT405-RM is installed on the CPA2850. Both the service access and service valve are connected to the low-pressure manifold of the compressor.

1. Turn the system off.
2. Bring the entire system, including both the CPA2850 and PT405-RM, to room temperature.
3. Use only high purity helium with a minimum purity of 99.999%.
4. Check that the helium source and regulator are capable of pressurizing to the desired pressure.
5. Make sure the service valve is closed.
6. Attach the service Aeroquip coupling to the service access port.

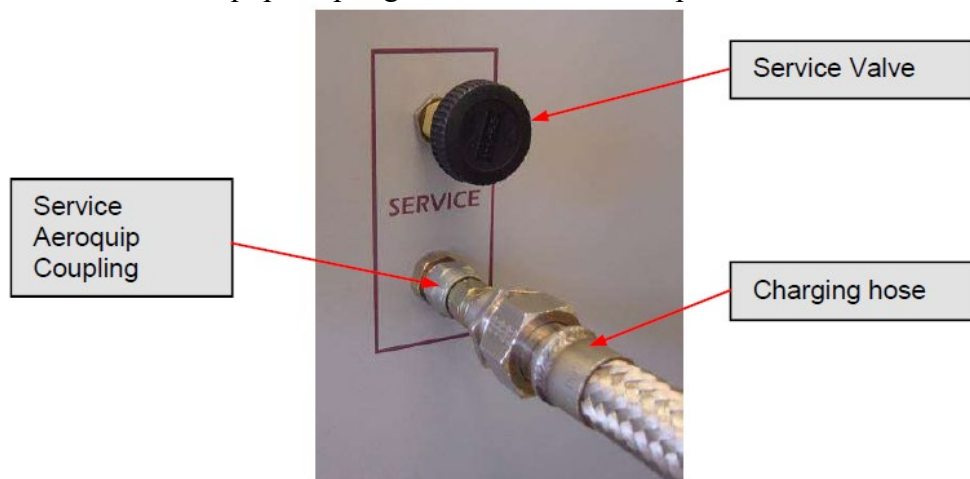


Figure 12 Service valve and access port

7. Attach a charging line from the service Aeroquip to a typical vacuum/charging system as shown in Figure 13 and Figure 14 below.

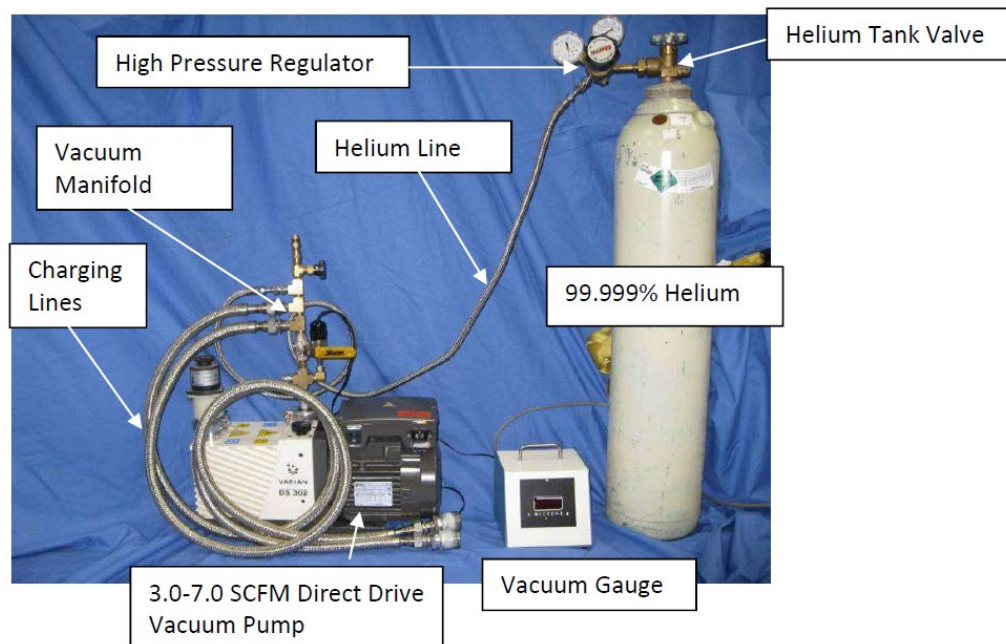


Figure 13 Vacuum/charging system

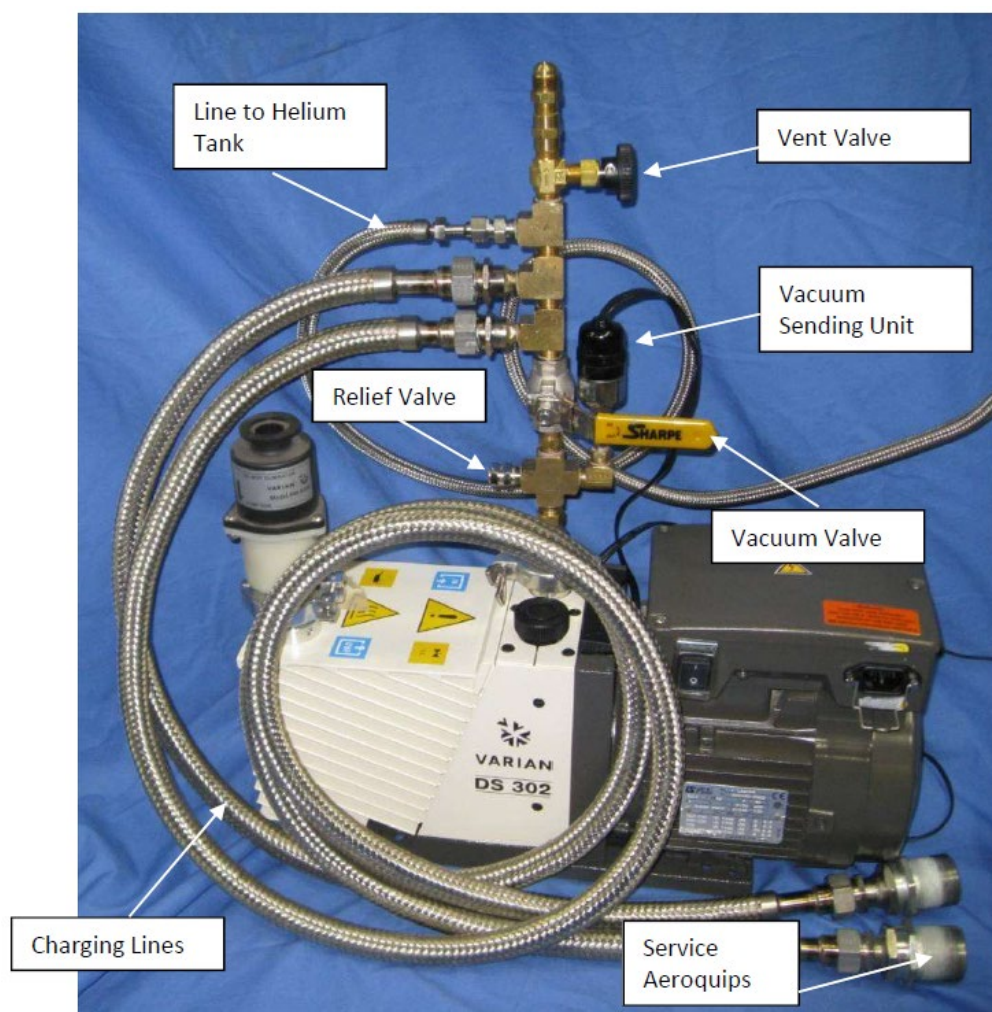


Figure 14 Close-up of vacuum/charging manifold and pump

8. Evacuate to 50 microns.
9. Isolate the vacuum pump and add 50 PSIG (3.4 bar / 340 kilopascal) of helium.
10. Vent the helium and repeat steps 8 & 9 at least once. Vent the helium and continue to step 11.
11. Final evacuation should be to 25 microns.
12. Pressurize the line to the service access with the desired amount of helium pressure.
13. Slowly open the service valve to add helium to the system.
14. After adding the helium, close the service valve and remove the service Aeroquip from the service access.

[CAUTION]: When adding helium, the helium must be at least 99.999% pure. Contamination by other gases will result in the freezing of the contaminant gases in the PT405-RM because their freezing temperature is much higher than that of helium. Contaminants in the helium charge will severely degrade the cold head's function and it will require factory servicing.

[CAUTION]: No more than 5 PSIG (.34 bar / 34 kilopascal) of gas should be added per minute to prevent internal oil contamination to the system.

6.5.5. *Cleaning*

PT405-RM + CPA2850

The compressor package and cold head require no cleaning other than wiping the outside of each if it becomes dusty or dirty. However, never wet either part. Water entering the system may cause malfunction.

Aeroquip couplings

If operated in a clean environment, the only parts of the cryocooler system that are likely to require cleaning are the Aeroquip couplings. The mating surfaces of the Aeroquip couplings can get particles on them when the helium flex lines are detached from the compressor package and/or the cold head. If an Aeroquip coupling needs cleaning:

- Wipe the mating surfaces of the coupling with a dry, lint-free cloth.
- After wiping, blow off the coupling with clean, dry compressed air.
- Solvents should never be used.
- If any grease or oil gets on the Aeroquip coupling, contact Cryomech.

[CAUTION]: Never remove an Aeroquip coupling from the helium flex lines, cold head or compressor without first relieving the helium charge. The pressure in any of the components can blow off the coupling with sufficient force to cause injury.

6.6. Alarm Trip Point

The cryocooler system monitor the temperature and the pressure and issues an alarm when they exceed beyond the appropriate range. Figure 15 shows the default values of alarm trip point.

Coolant In Temp °F	
High Alarm:	110
High Warn:	85
Low Warn:	45
Low Alarm:	40

Oil Temp °F	
High Alarm:	125
High Warn:	120
Low Warn:	45
Low Alarm:	40

Coolant Out Temp °F	
High Alarm:	125
High Warn:	120
Low Warn:	45
Low Alarm:	40

Helium Temp °F	
High Alarm:	190
High Warn:	170
Low Warn:	45
Low Alarm:	40

Motor Current Amps	
Low Alarm:	5

Low Pressure Line PSI	
High Alarm:	250
High Warn:	240
Low Warn:	40
Low Alarm:	35

High Pressure Line PSI	
High Alarm:	400
High Warn:	375
Low Warn:	170
Low Alarm:	150

Delta Pressure Line PSI	
High Alarm:	300
High Warn:	290
Low Warn:	75
Low Alarm:	50

Figure 15 Default values of alarm trip points