

Delay Line ICD Allocations and N² Diagram Subset

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Introduction

The list of Interface Control Documents (ICDs) presented in version 3 of this document is now agreed between NMT and MRAO. The individuals who will be responsible for producing them have also been assigned. The intention is to have these ICDs completed, if not finally agreed and signed-off by the final design review. The revised list of ICDs is as follows:

- ICD: Delay line to ICS (INT-406-ENG-0002)
- ICD: Delay line to Beam Relay system (INT-406-VEN-0008)
- ICD: Delay line to BCF infrastructure (building) (INT-406-VEN-0009)
- ICD: Delay line to metrology system (INT-406-VEN-0010)
- ICD: Delay line to vacuum system (INT-406-VEN-0011)
- ICD: Metrology System to BCF (INT-406-VEN-0012)
- ICD: Delay line to Beam Relay System (INT-406-VEN-0013)

The remainder of this document discusses the ICD list and presents a table of the ICDs with an indication of what each one covers. This list cannot be a definitive statement of the contents of each ICD as that is the work of the owner of the ICD who should aim to provide this in the first ICD release. Also included is an N² diagram which is a system engineering tool that is used to identify and monitor ICDs and their development.

The List of ICDs

The ICDs identified so far from WBS headings are shown in Table 1. This lists the ICD number allocated, the two subsystems between which the interfaces are defined, the organisation (NMT or MRAO) and proposed 'owner' of the ICD, and the primary purpose with an indication of the preliminary contents expected to be covered by the ICD. The 'owner' of an ICD is the person responsible for its production.

The proposed owner of the ICD is responsible for the production of the ICD though others may be required to define and produce the contents. For example, an ICD might require the production of mechanical drawings to define fittings or space envelopes. Another example might be the detailed interfacing of the Interferometer Control System to the Delay Line subsystem which would require input from the system architects as well as the software and teams at NMT and MRAO.

There is one area where several ICDs meet and, to some extent become interdependent. This is the BCF area where the beam relay pipe, the delay line pipe, the metrology system and optical tables etc are all in the same room. Care will be needed in defining the exact contents of these ICDs so that nothing is overlooked but more importantly that all the ICDs are linked such that the ramifications of any potential change are fully determined.

A particular example of this interdependence between ICDs is where more than one ICD may involve the same component. The end plate of the delay line pipe houses the optical windows for the metrology beams and science beam and also couples to the beam relay pipe. The interface documents for the Beam Relay to Delay Line and Delay Line to Metrology System will refer to the design drawing for the whole end plate but not the location of the pipe(s) with respect to the metrology table or the walls of the BCF since this is handled by the Delay Line to BCF ICD. In a

sense the Delay line does not care where the metrology bench is or what arrangements are made to get the light into it but if, for example, there was a restriction on how close to the window any other component could be then the Delay Line ICDs must include this in the form of an 'exclusion zone'. An example of this might be that 300mm of clear space is needed in front of the faceplate to allow its removal without disturbing the metrology system.

The N² Diagram

This is a system engineering tool which is used to identify and monitor interfaces between subsystems. It is very often used for large projects or complex ones which have lots of interfaces or potential interfaces. It is not intended to be restricted to interfaces which occur between different organizations or groups but is specifically for managing all interfaces between subsystems. Subsystems are generally defined or bounded by the Work Breakdown Structure (WBS) of a project and so the N² diagram is often based on the WBS entries.

The N² diagram is intended to show which subsystems have formal interfaces and therefore ICDs between them. It can also be useful for identifying interfaces that are not immediately obvious and for monitoring progress in ICD production (e.g. it can serve as a reminder as to which ICDs are in place and which subsystems may be holding up a set of ICDs from being signed-off).

The N² diagram for those WBS items which impinge on the Delay Line project is shown in Figure 1. This could be described as a subset of a larger N² diagram for the whole MROI project. This particular version includes information on the organisation and 'owner' of each ICD. The 'owner' subsystems are arrayed across the top of the diagram and the 'subordinate' subsystems are listed in a column at the left. The 'owner' subsystems are responsible for producing the ICDs listed below them (the designated owner and organization is given in []s). The 'subordinate' subsystems are affected by the ICDs listed across from them (the organization(s) involved are given in []s). There is no particular methodology that defines which subsystems should be owner subsystems but the subsystem which generally drives the interface requirements, has the most information to impart or is best placed to provide the individual responsible for the production of the ICD is likely to be the obvious candidate.

There is just one ICD (ICS to Delay Line) on this diagram that requires interchange between NMT and MRAO. In this particular case the status of the ICD is not clear because of the nature of the contract for the supply of a prototype delay line subsystem. For now the ICD should apply to the system and software to be provided with the first production trolley and delay line designs. At some later time it could be revised to describe the interface between the final delay line designs and the ICS.

There may well be a need to take into account other influences if not interfaces between the building and its contents by defining more ICDs within this subset though they may not specifically impinge on the delay line contract and MRAO work. For example, there are probably interfaces between the Vacuum System and the BCF and Beam Relay System. These things are not addressed in this document.

Table 1 Delay Line ICD List

Item	ICD Number	Sub-systems		Org	Owner	Brief description and preliminary contents
1	INT-406-ENG-0002	Delay line	ICS	NMT	TC	Defines the communication and control interface between the ICS and the delay line. <ul style="list-style-type: none"> Needs input from system architects and MRAO software team)
2	INT-406-VEN-0008	Delay line	Beam Relay system	MRAO	MF	Defines the mechanical interface between the delay line pipe and the beam relay pipe. <ul style="list-style-type: none"> Probably one drawing of the complete face-plate and the specified flange arrangement
3	INT-406-VEN-0009	Delay line	BCF infrastructure (building)	MRAO	MF	Defines the mechanical and space envelope interfaces between the delay lines and the BCF (DLA and BCA areas). <ul style="list-style-type: none"> Layout of delay line pipes and interface of supports to floor Interface between delay line pipes and walls Services requirements and placement of control racks
4	INT-406-VEN-0010	Delay line	Metrology system	MRAO	RCB	Defines the opto-mechanical and electronic interfaces between the delay lines and the metrology system. <ul style="list-style-type: none"> Geometric requirements for metrology beams – positions, sizes Control signals and communications Probably includes the drawing of the complete face-plate.
5	INT-406-VEN-0011	Delay line	Vacuum system	MRAO	MF	Defines the mechanical interfaces on the delay line pipe required to connect to the vacuum system. Should also include electrical interfaces if any are identified. <ul style="list-style-type: none"> Vacuum port connection Sensor port(s) Safety mechanism and signalling if applicable
6	INT-406-VEN-0012	Metrology System	BCF	MRAO	RCB	Relates metrology bench, services and electronics racks etc to BCF (BCA) area. <ul style="list-style-type: none"> Location and requirements of metrology bench Location and requirements of electronics racks Service connections, heat removal etc.
7	INT-406-VEN-0013	Metrology System	Beam Relay System	MRAO	RCB	Defines space envelope for beam relay pipes above metrology table. <ul style="list-style-type: none"> One drawing defining beam relay pipe position.

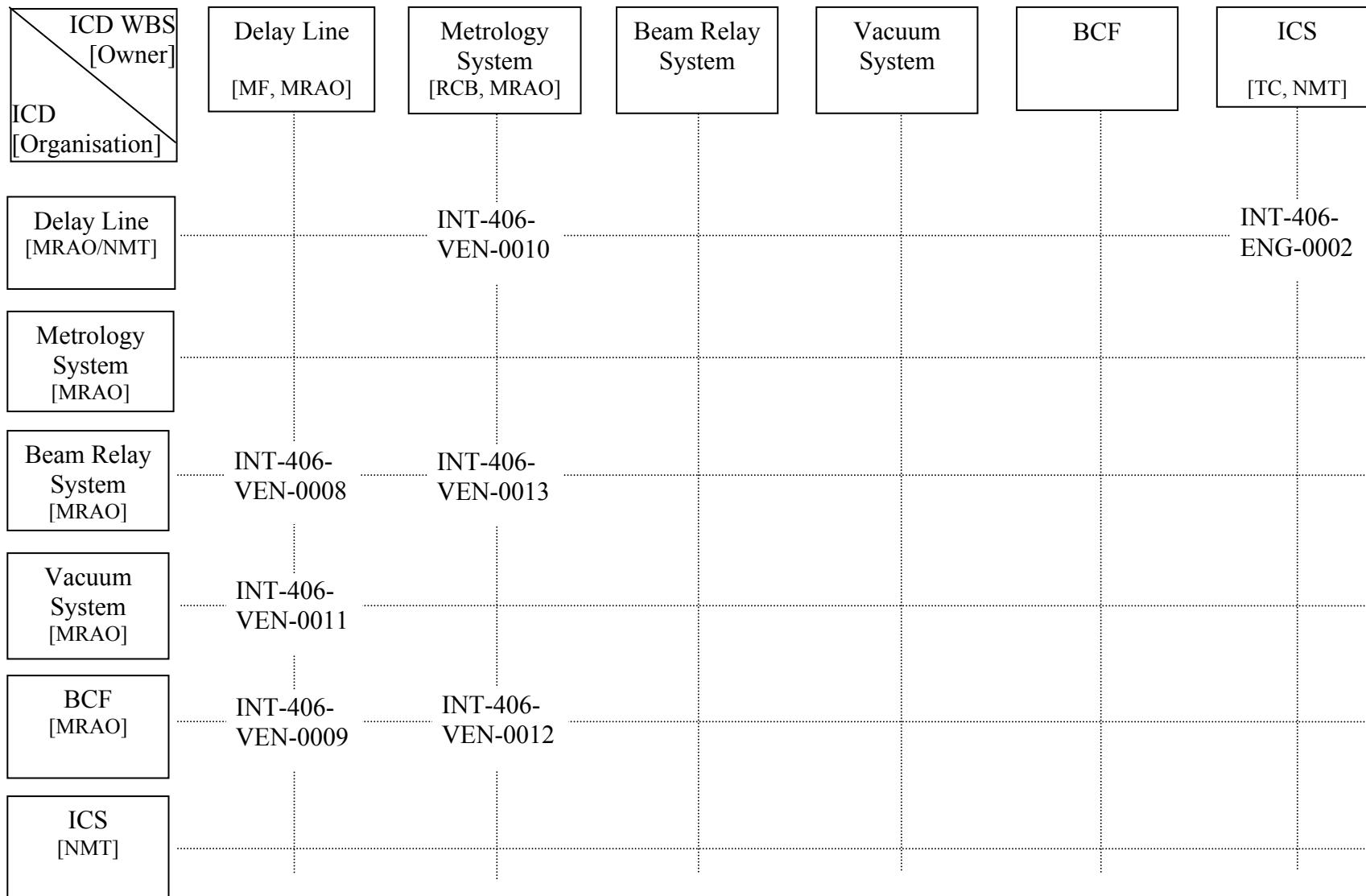


Figure 1 N² diagram of subset of MROI Project ICDs which concern MRAO. The ‘Owner’ subsystems are arrayed across the top and are responsible for producing the ICDs listed below them. The ‘Subordinate’ subsystems are listed at the left and are affected by the ICDs listed across from them.