DRAFT

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8.4 MRLs for Single or Limited System Acquisition

Manufacturing readiness assessments using the MRL criteria can be adapted for the acquisition of a single system or limited production systems. A single or limited production system is defined as a system in which the first unit becomes the first operational unit, e.g. a large scale radar, a class of ships, or a single or small family of satellites.

8.4.1 Single or Limited Systems – except Ships

Assessments of this type of system are accomplished by modifying the relationship of MRLs to decisions points or milestones. Prior to CDR, as these systems proceed normally through the acquisition process, assessments of manufacturing readiness using the MRL criteria are performed through Milestone B as described in Section 3 (or if there is no Milestone B decision planned then through PDR).

Per DoDI 5000.02, 5.d.(10)(b):

> *Some programs, notably spacecraft and ships, will not produce prototypes during EMD for use solely as test articles because of the very high cost of each article. In this case, the first articles produced will be tested and then fielded as operational assets. In this case, the first articles produced will be tested and then fielded as operational assets. These programs may be tailored by measures such as combining the development and initial production investment commitments. When this is the case, a combined Milestone B and C will be conducted. Additional decision points with appropriate criteria may also be established for subsequent low rate production commitments that occur prior to OT&E and a Full-Rate Production Decision.*

Whether traditional or tailored, a CDR that assesses design maturity, design build-to or code-to documentation, and remaining risks and establishes the initial product baseline, is required. Manufacturing maturity at CDR must be sufficient to support a First Build decision point *with acceptable risk*. First Build approval and First System Build normally occur shortly after successful CDR completion (see Figure 8.3). Although the build occurs during EMD, this is also the first (and possibly only) production system. As such, to achieve an acceptable level of risk, the system level manufacturing maturity must meet MRL 8 criteria at the CDR decision point, and the sub-system and component levels maturity must meet MRL 8 or 9 criteria. As a waypoint in mid-development

between PDR and CDR, an assessment against the MRL 7 criteria may be performed to meet program objectives.

In addition, for space systems, where hardware replacement or repair is not possible and quality and reliability are of paramount importance, the initial units (i.e., EMD units for satellites) are required to meet all mission operational requirements. This dictates complete documentation and traceability of all flight units (the "as-built" documentation), which is key in support of on-orbit anomaly analysis. Quality and reliability must be emphasized when conducting manufacturing readiness assessments of space vehicles.

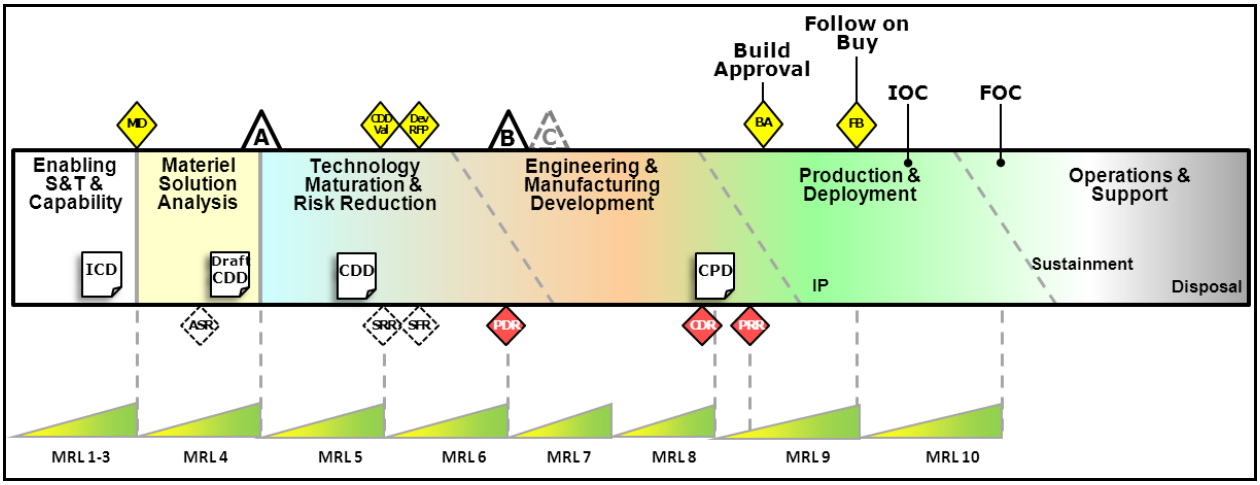

Figure 8.4.1
Single or Limited System Acquisitions – except Ships
Relationship of MRLs to Decision Points

Certain criteria and language in the MRL threads and sub-threads may require adhering to a more stringent definition to meet the requirements for single or limited system acquisitions. For example, in the Materials Maturity sub-thread (D.1), MRL 7, "Material Maturity sufficient for pilot line build," sufficient means fully characterized. For MRL 8, "Materials proven and validated during EMD as adequate to support LRIP," as LRIP is the initial production EMD system, adequate means fully proven and validated. The strict adherence to a high-level definition reduces risk for successful product ion of single or limited systems where manufacturing risk control is a primary concern.

Another example, in the Manufacturing Process Maturity sub-thread (E.2), demonstrating and verifying manufacturing processes can be difficult, as can collection and calculation of process capability when producing a single system. Existing proven and capable manufacturing procedures and processes should be utilized for production process verification as much as possible and equipment utilized must meet capability requirements.

8.4.2 Single or Limited Systems – Ships

In the case of ship acquisition, a complex Systems of Systems, the major systems and subsystems should be fully characterized, if not in production (i.e., MRL 8 or 9) before ship CDR. At the overall ship development level, as MS B typically takes place three to six months after CDR, the overall ship design should be at MRL 7 by MS B.

Multiple shipyards may be working independently to prepare functional designs in accordance with their particular shipyard's production methodology and processes, moving their designs towards MRL 8.

In order to improve governance and insight, ensure alignment between capability requirements and acquisition, improve senior leadership decision making, and gain better understanding of risks and costs, the Department of the Navy has implemented a "2-pass, 6-gate" process. **Gates 1, 2, and 3** are "requirement gates", starting prior to Materiel Development Decision which lead to approval of the ICD, the AOA guidance, section of an AOA "optimal" alternative, approval of a CDD, development of a CONOPS, and approval of System Design Specification (SDS) Development Plan. At System Design (SD) 1 Final Design Review (equivalent to PDR) the system maturity should be at MRL 6. **Gates 4, 5, and 6**, the "acquisition" gates, start after Gate 3, end after Milestone B (initial EMD phase). This process results in approval of the SDS, releasing of the RFP, **assessing readiness for production,** and approve the IBR. Post Gate 4 (and potentially Gate 5) with the SD2 completion (equivalent to CDR) at Milestone B (MSB), the system maturity should be at MRL 7.

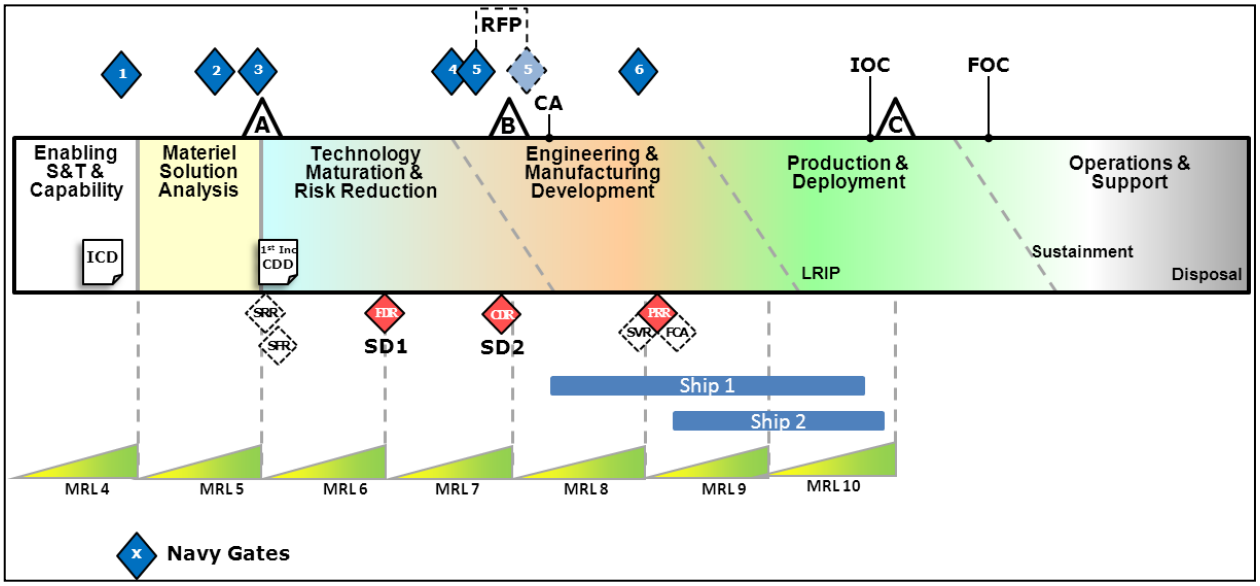

Figure 8.4.2
Single or Limited System Acquisitions – Ships
Relationship of MRLs to Decision Points

Once MS B has taken place, the ship's detailed design and construction begins. With Contract Award (CA), the winning shipyard continues with the design and construction in preparation for PRR at MRL 8. A year or more may elapse between Contract Award and PRR, with PRR required before the LRIP/lead ship construction start decision (laying the keel) and follow-on ships.

For ships at CDR all major ship sub-systems (propulsion, weapon systems, combat systems, C4I, etc.) required for the platform to function as a ship should be at MRL 8. Also, any sub-system in this systems-of-systems that is not possible to replace or retrofit must be at MRL 8. To reach this level of maturity, modeling and simulations, including potentially building full scale subsystems (not part of the ship systems) may be used.

8.4.3 Summary

In summary, assessments of manufacturing readiness based on MRL criteria can encompass single or limited system acquisitions with adaptions to the assessment process and maturity required at decision points or milestones.