

System-Level TRL 6 Examples

The NASA Science Mission Directorate (SMD) opportunity – for which this document is being provided – contains a requirement that states in part that “[p]roposals that use systems currently at less than TRL 6 shall include a plan for system maturation to TRL 6 by no later than PDR...” Satisfaction of the requirement – in particular any associated tests in a relevant environment – is dependent on the nature of the proposed mission or investigation. *It does not necessitate a system-level test by default. Having all components or even subsystems at, or above, TRL 6 does not automatically satisfy the requirement.*

The examples below provide possible scenarios where system-level TRL 6 is demonstrated. Proposing teams should address the requirement according to their mission or investigation’s unique system considerations, including stages of development.

Example 1: An imaging instrument (i.e., the overall system) is identical to a flight-proven instrument, except for the incorporation of a newly developed solid-state single-photon-counting detector, and will operate in the same environment. Prior to PDR, a high fidelity prototype of the detector subsystem is to be built, adequately addressing all critical scaling issues. Testing of the detector subsystem is expected to demonstrate successful operation of the subsystem in a relevant environment. Prototype software will be used for a partially integrated test using a full-scale realistic problem. Interfaces between the newly developed subsystem and the balance of the system are not expected to change. Nor will there be any critical alignment considerations between the newly developed subsystem and the balance of the system. Consequently, the system demonstration can be accomplished by the performance of the subsystem test and an associated, straightforward justification that the system would operate in a relevant environment, as predicted, upon integration of the newly developed subsystem.

Example 2: If, in example 1, the imaging instrument had only been demonstrated to be at TRL 6, the incorporation of a newly developed solid-state single-photon-counting detector may still only require testing of the detector subsystem in a relevant environment. However, system demonstration will require a more robust justification – at a minimum, the details of the system level TRL 6 demonstration of the original instrument and how the system would operate in a relevant environment, as predicted, upon integration of the newly developed subsystem.

Example 3: An instrument has been demonstrated to be at TRL 6, but the detector is to be replaced by a higher performance subsystem that has itself been demonstrated to be at TRL 6. For this example, assume that there is a critical alignment requirement between the detector subsystem and another subsystem. In this case, both subsystems will have to be tested together in a relevant environment. The same would apply in the case of any advanced engineering effort required to integrate subsystems. Demonstration of TRL 6 at the system level will require a robust justification that the system would operate in a relevant environment, as predicted, upon the integration of the tested subsystems.

Example 4: In the case of a completely new design with significant technology and/or advanced engineering developments at lower levels, a system level test in a relevant environment may be required.

In all instances, proposing teams must use engineering judgment to establish how TRL 6 at the system level will be demonstrated. The evaluation of proposals will apply analogous engineering judgment.