Down-select criteria: inputs and considerations

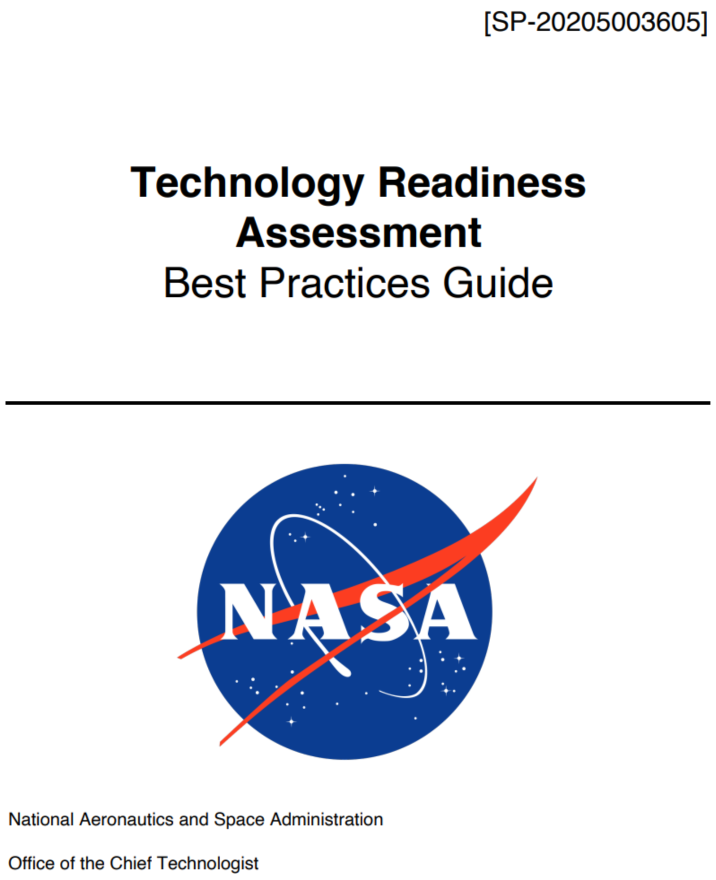
- Performance: major driver
  - Physics benchmarks
  - Detector level
- Cost: major boundary conditions
  - Estimates: total cost, key components
- Technical maturity
  - A key feature for *Technical Design Report*: distinguishable from *Conceptual Design*

Down-select criteria: a first template

Category	Items	Details	Priority	Remarks
Performance	Boson Mass Resolution (BMR)	BMR<4%	A	H/Z/W/top full physics programs
	Detector	EM/hadronic energy linearity and resolution	A	
		Separation Power (only for 2 particles?)		Incident angles; particle energy
		π^0 Resolution	B?	(Mostly) Flavor physics, potentials in jets
Cost	Total Cost Estimates	Key components and crucial uncertainties		Availability, lead time and possible risks
Technical Readiness Level	Review of existing prototypes	TRL score: 1-9		TRL will also need separate/dedicated criteria

Priority for performance/detector requirements & specs: (A) must-have; (B) plus; (C) not essential

TRL: extra information



[SP-20205003605]

Technology Readiness Assessment
Best Practices Guide

National Aeronautics and Space Administration

Office of the Chief Technologist

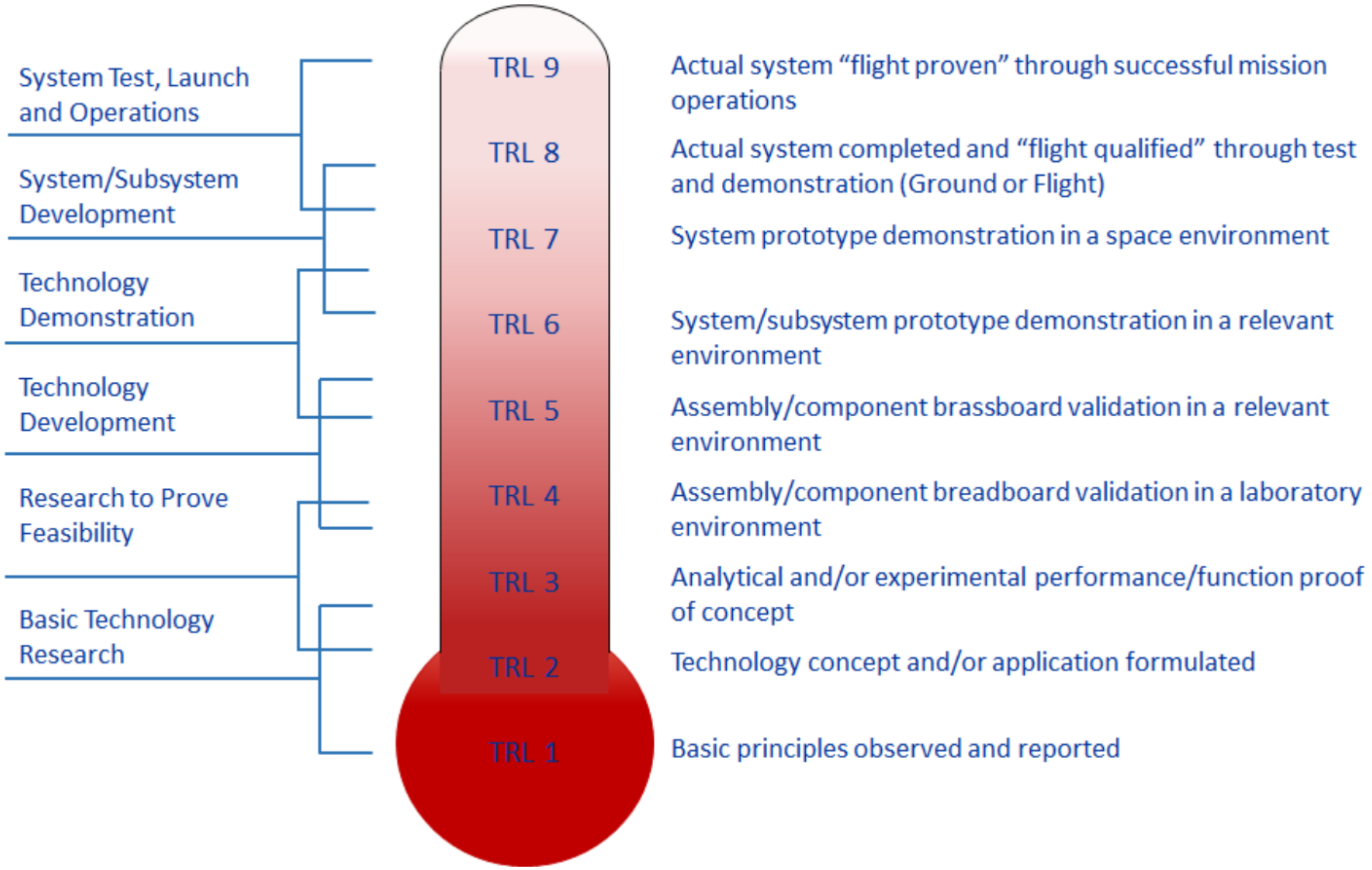


Figure 2-1: Thermometer Scale for NASA’s Technology Readiness Levels

https://ntrs.nasa.gov/api/citations/20205003605/downloads/%20SP-20205003605%20TRA%20BP%20Guide%20FINAL.pdf

TRL: extra information

Technology Readiness Level (TRL) Scale

TRL is based on a scale from 1 to 9, with 9 being the most mature technology. Using TRLs enables consistent, uniform discussions of technical maturity across different technologies. Decision authorities will consider the recommended TRLs when assessing program risk. [1,2]

Level	Definition	TRL Description
1	Basic principles observed and reported	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include paper studies of a technology's basic properties.
2	Technology concept and/or application formulated.	Invention begins. Once basic principles are observed, practical applications can be invented. Applications are speculative and there may be no proof or detailed analysis to support the assumptions. Examples are limited to analytic studies.
3	Analytical and experimental critical function and/or characteristic proof of concept.	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.
4	Component and/or breadboard validation in laboratory environment.	Basic technological components are integrated to establish that they will work together. This is relatively "low fidelity" compared to the eventual system. Examples include the integration of "ad hoc" hardware in the laboratory.
5	Component and/or breadboard validation in relevant environment.	The Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so it can be tested in a simulated environment.
6	System/subsystem model or prototype demonstration in a relevant environment.	A representative model or prototype system, which is well beyond that of TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness.
7	System prototype demonstration in an operational environment.	Prototype near, or at, planned operational system. Represents a major step up from TRL 6, requiring the demonstration of an actual system prototype in an operational environment such as an aircraft, vehicle, or space.
8	Actual system completed and qualified through test and demonstration.	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental test and evaluations of the system in its intended weapon system to determine if it meets design specifications.
9	Actual system has proven through successful mission operations.	The actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation. Examples include using the system under operational mission conditions.

https://acqnotes.com/acqnote/tasks/technology-readiness-level

Feedback from Manqi

- Performance: BMR, PID in Jets
- Solve - Overlap in Z decay (~ns) ~ 1% level occupancies
- Integration
- Power Consumption - Cooling
- Mechanics
- Data stream
- Tech. (Electronic) & Accessibility
- Tech. Spin-off

Updated inputs for selection criteria: calorimetry system

- Performance
  - BMR < 4%
  - PID in jets: lepton ID, (plus hadron ID)
  - EM energy resolution
  - Pi0 reconstruction: efficiency, purity, mass resolution
  - Pile-up at Z-pole
- Technical options
  - PFA-oriented
    - Plastic scintillator ECAL and HCAL
    - Silicon ECAL, glass-RPC HCAL
  - 4^{th} conceptual design: crystal/glass ECAL (several geometry options), glass HCAL
- Status: to be confirmed (including full simulation, prototyping R&D, performance)
  - Plastic scintillator ECAL and HCAL: Yunlong
  - Silicon ECAL, glass-RPC HCAL: Haijun
  - Crystal/glass ECAL: Yong, Huaqiao
  - Glass HCAL: Sen
- Boundary conditions
  - Longitudinal depth: ECAL=$24X_0$, HCAL=$6\lambda_I$; detector geometry (constraints to be reviewed)
  - Baseline geometry: R_in=1.8m, L=5.0m
- Electronics
  - Inputs of electronics for calorimeters: Jinfan Chang (invited for further discussions),
  - Power consumption and cooling
- Cost estimates
  - Electronics (number of channels), …

Re-convene for further discussions:
on Feb. 23, 2024