



# **Management of Experiments as Projects**

**PMI Monthly Meeting**

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# Management of Experiments as Projects - Overview



- Objective: share successful techniques from several experiments & demonstrations
- Types of R&D: Basic, fundamental & applied
- Possible outcomes:

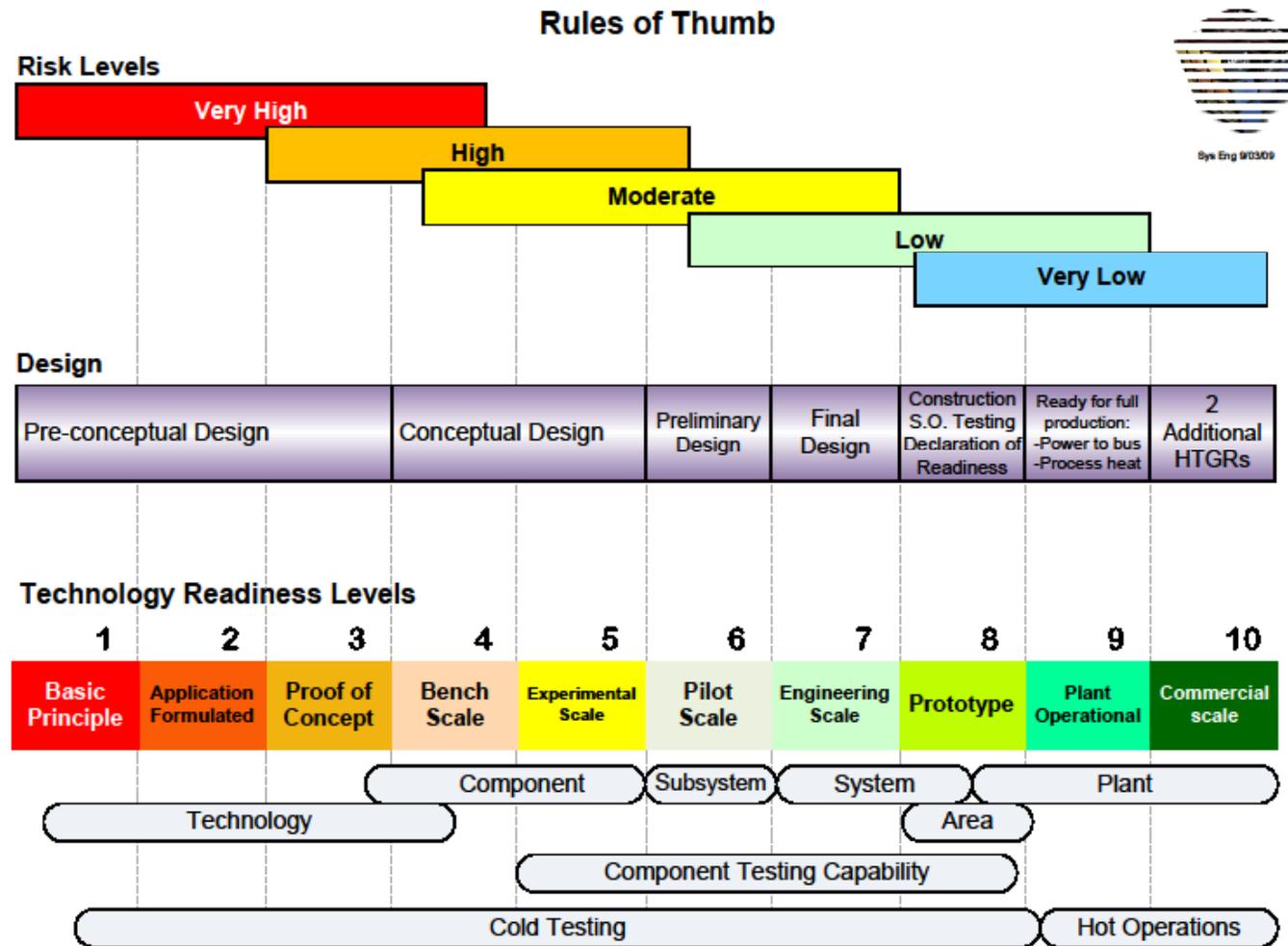
Experimental Failure Project Failure	Experimental Failure Project Success
Experimental Success Project Failure	Experimental Success Project Success

***How do you predict, schedule, & budget an intellectual breakthrough?***

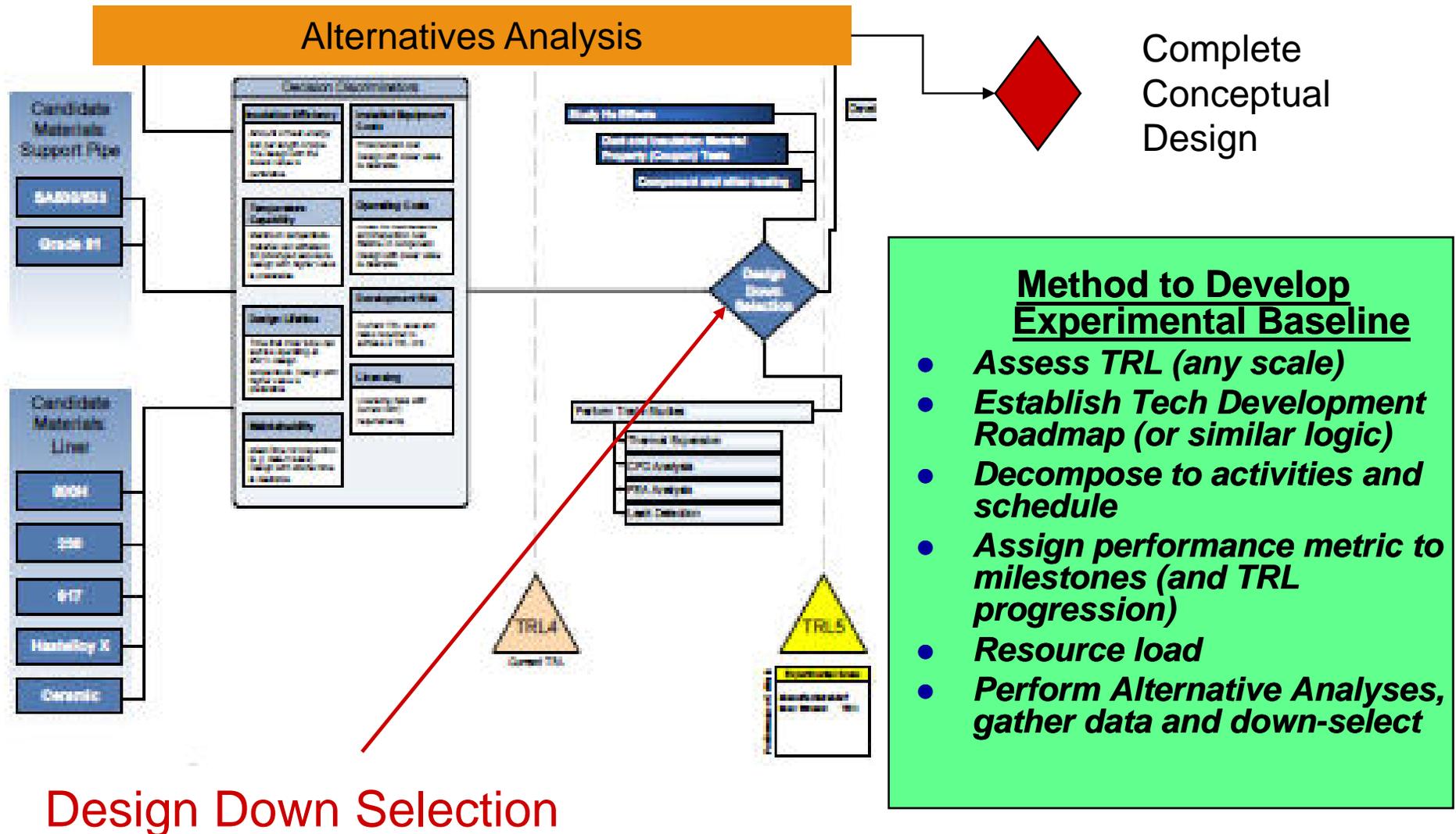
# Form a Baseline based on Technical Readiness Levels (TRLs)



***“Breakthrough” achieved by performance metrics to advance from one TRL to the next – production, efficiency, hours of operation, etc.***



# Perform Experiments as part of Concept Design Alternatives Analysis

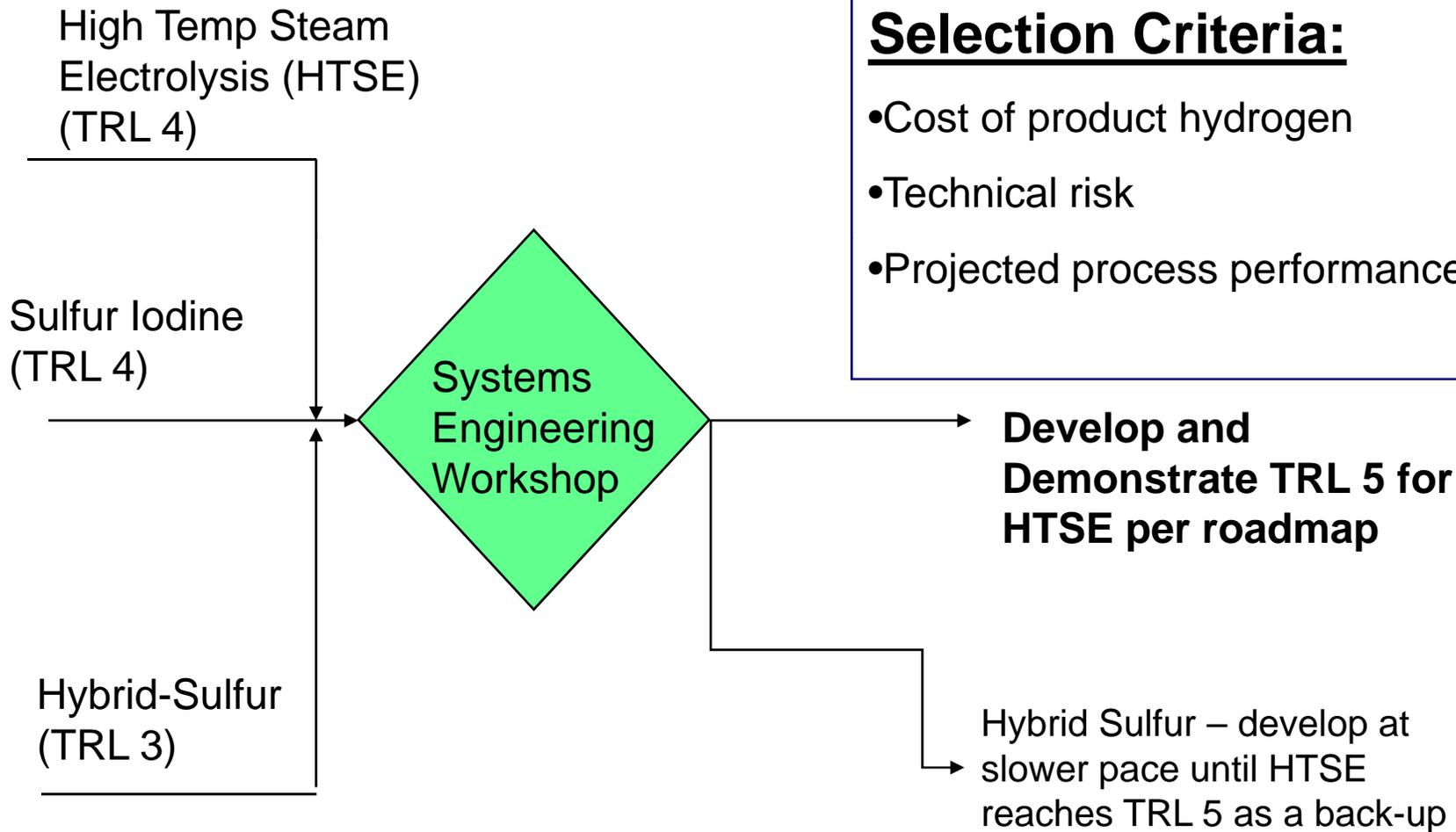


# NGNP Example – Results of Hydrogen Process Down-Selection



## Selection Criteria:

- Cost of product hydrogen
- Technical risk
- Projected process performance

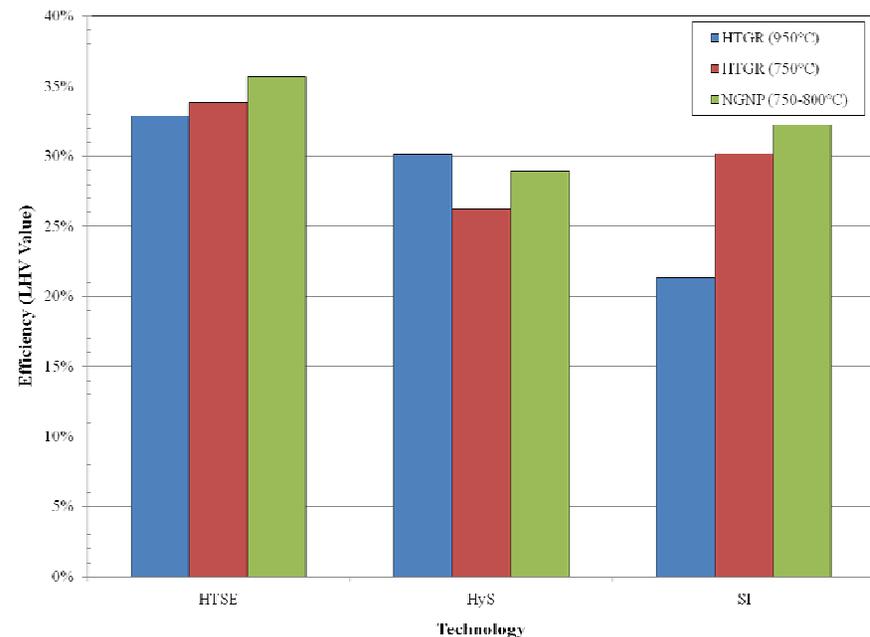


# H<sub>2</sub> Data generated as part of Alternatives Analysis



- Independent Review  
Team reviewed data & made recommendation
- Conceptual Design & next set of experiments proceed based on down-selection
- Down-selection avoided ~ \$140M in SI development costs
- SI Process Demonstration
  - Project Success? ↑
  - Experimental Success? ↓

Technical Risk Data



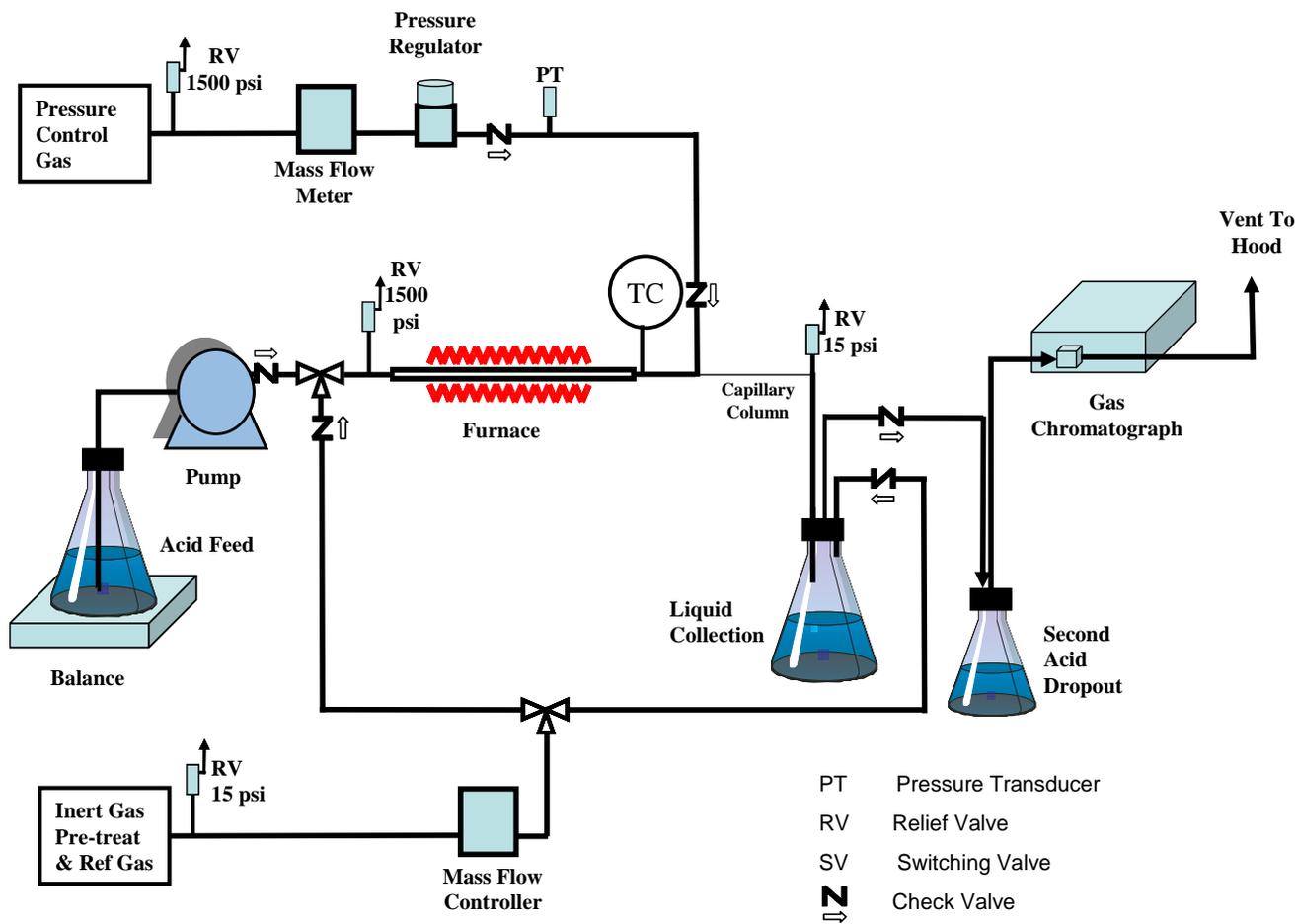
**Relative Overall Scores**

HTSE	HyS	SI
3.5	2.9	2.1

# Small Example of Experiment gathering Fundamental Data



## 1000 Hour Catalyst Test



- Accepted PM role to support H2 Down-selection
- Tight schedule
- Mixed fund sources
- Similar to previous experiments *except* at higher pressure
- Cost estimates based on verbal quotes for high pressure parts
- Back-up GC in place in case of equipment failure
- Completion part of performance fee calculation

# 1000 Hour Catalyst Test - Continued



- Experimental Success –
  - Demonstrated catalyst performance to high degree of accuracy
  - Identified failure mechanisms
  - Advanced technical maturity
- Project Failures
  - Late start – slow deliveries, equipment changes equipment due to higher-than-quoted costs, slower than promised funding
  - Multiple (5) GC failures forcing re-start
  - Draw-down on MR complicated by multiple B&R codes
- Project Successes
  - Early communication with customer
  - Finished in time to support Hydrogen Down-Selection
  - No impact on fee

# Other Notable Learning Opportunities



- AGC-1 Mock-up Demo
  - No Technology Readiness basis for alternatives studies or design selections
  - Significant fee without objective performance criteria
  - Significant turn-around: after schedule developed for negotiated performance objectives
  - Project Success →
  - Experiment Success ↑



N. Holmes Lab Mock-up

# Other Notable Learning Opportunities - Continued



- LDUA Deployment
  - No identified customer
  - Performance criteria not identified (scope creep)
  - Inadequate alternative analysis
  - Baseline not maintained
  - When customers were identified:
    - Performance objectives set
    - Baseline schedule established
    - 3 HLW Tanks eventually characterized
  - Project success →
  - Experiment success ↗



# Lessons Learned - Recommendations



- Maintain financial control as PM
- Establish a baseline schedule based on roadmaps/logic diagram and outcomes
  - Performance criteria linked to outcomes and milestones
  - Pre-agreed off-ramps
    - If experiment doesn't achieve expected performance
    - Based on down-selections controlled by PM
- Identify your customer(s) and communicate
- Be willing to turn down work – not all experiments can have positive project outcomes