Requirements and Waivers

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Abstract

Good requirements are the first step for good communications, and good communications are central to insure an understanding between the customer and contractor. Failure to generate good requirements is unfortunately commonplace and repeated. Waivers to requirements are discussed from a risk based point of view. The assumption that every requirement will eventually be waived is used to establish a critical review of a draft safety requirement. Validation methods of requirements are addressed. Value added that safety requirements contribute to the Project is estimated to further our critical review of draft requirements.

Introduction

The first and fundamental issue is to recognize the difference between a standard and a requirement. Standards typically provide a general set of useful design attributes, or operational criteria. A standard is a document listing either technical engineering design practices in a specific field. Tailoring the standard and levying it in a contract represents the standard evolving into a requirement. Requirements fall into 2 categories: those with a technical basis and those with no technical basis.

No requirement is perfect. The assumption that Program forefathers created perfect & timeless requirements is not valid. A requirement can not be written to account for all special cases. In addition, environmental conditions and assumptions on which the requirement is based constantly change.

Requirements

A checklist of useful requirement's attributes and things to avoid in generating a good requirement may help:

- Do the requirements contain only verifiable and measurable essentials? Nice to have ideas have no place in a concise set of requirements.

- When developing a requirement by tailoring an existing standard, keep in mind that the only portion of the standard that needs tailoring are things impacting schedule and funding.

- The requirements must be sufficiently detailed to permit the bidder to estimate schedule and labor. Suggestion – When the first draft Request for Proposal (RFP) is complete, 2 or more safety professionals should bid each requirement based on the RFP verbiage and compare their bids. If the bids disagree beyond a pre-established range, then the requirement needs rework.

- Proposal language must be clear. When drafting the RFP, avoid pronouns and do not be concerned with any awkwardness when restating the noun.

A checklist related of the requirements generation process includes:

- Identify assumptions, constraints, and limitations.

- Separate background information and contract objectives from technical requirements.

- Explain interrelationships between tasks and deliverables.

- Deliverable reports are normally tied to milestones such as the Preliminary Design Review, Critical Design Review, etc. Regarding the scheduling of deliverable reports, exercise caution, especially when the design is only for a simple piece of hardware. For example, a report may be required to be delivered 30 to 60 days before a design review for seemingly good rational allowing the Government or customer time to review the report and cycle it back to the contractor with adequate time to incorporate comments. The contractor typically has an internal review process for the draft report of 30 days before its release to the Government. The contractor's safety engineer needs 15 days to complete the draft report before entering the contractor's internal review and approval process. The caution is that the report can be scheduled for delivery in the presence of process restrictions that back up the time so that the contractor's safety engineer must complete his draft before the designer commences with the design.

Requirement Assessment Strategy

Examples of processes for assessment of requirements are shown in the tables in this section. Table 1 is used by NASA's Constellation Program CxP-01010 – Crew Exploration Vehicle (CEV) to Lunar Surface Access Module (LSAM) Interface Requirements Document. The author's requirement's assessment evaluation process is shown in Table 2. The checklist provides useful information for requirements evaluation and expands some of the headings in the tables:

- Is the requirement technically based? If a waiver is requested, are there engineering equations or engineering tables to support waiver rationale?

- Is the requirement risk based? Assumptions: (1) Both personnel and flight hardware exposed to the hazard risk. (2) Residual risk normally exists in presence of full compliance to the requirement. The risk is represented by a probability that the risk will materialize into a problem and contribute to a mishap.

  A change in risk is estimated in the presence of a waiver of a requirement. This risk change should be checked against the noted residual risk of compliance to the requirement. Often there is no change for hardware risk that can be noted within the constraints of the risk management matrix. An example is the Space Shuttle Challenger Solid Rocket Booster seal burn mishap. Both Marshall Space Flight Center engineers and Thikol engineers conducted test to better understand risk associated with seal damage with a result which would have shown no change in the risk matrix in the opinion of the author.

- Does the requirement get the attention of the contractor? Working tasks (requirement) interest the contractor or supplier. The task must be biddable in a source board process with an estimated dollar value. Contractors focus on requirements that impact schedule or budget. Examples of attention getting requirements may be a deliverable report or a design feature. When there is a risk, then a contractor should be paid for that risk.

- Is the requirement verifiable? Methods of validation of each requirement must be considered. Analysis, similarity, test, review of documentation, and inspection are common methods of requirements verification. Unverifiable requirements serve little value.

- What is the estimated value added of the requirement as applied to improving hardware robustness?

Requirements Change Evaluation Process used for NASA's Constellation Program is provided below:

Description:
• State purpose of item and what's being requested of the board (approval to proceed, status only? etc.) including a brief description of the change request /action item.
• What Program requirements are being developed, revised, and/or waived?

• Brief history of issues and/or concerns.

Risk Summary:
• Summarize the risk associated with the topic.
• What is the SR&QA interest in this topic?
• How will the requirements be verified e.g., test, analysis, similarity, simulation, etc.?
• Are there alternative requirements? i.e., are we limiting to one design solution? If so, is that best or acceptable from an SR&QA perspective?
• Identify and explain applicable options for this topic.
• What is not being presented or brought forward for discussion? (Potential risk or minority opinions?)
• Provide explanation and/or justification for all "YES" answers as a minimum from the attached SR&QA checklist.

Recommendation Rationale:
• Provide justification for the S&MA recommendation.
• What analysis has S&MA performed (risk analysis or trade studies)?
• What have we assured/verified (e.g. failure history, requirements, and references)?

Sect. 3 Para. Ref.	REQ. DESCRIPTION Title	METHOD (Test, Demo., Analysis or Inspection)	PLAN # (indicate which plan describes the verification of the requirement)	LEVEL (Component, Subsystem, System)	Respon-sibility	Remarks

Table 1— Sample Verification Requirements Traceability Matrix

Requirement	Technically based Yes/No	Waiver risk	Verification - Test	Verification - Simulation	Verification - Document Review	Verification - Analysis	Verification - Inspection	Not Verifiable	Design or Working Task Yes/No	Residual Risk @ Full Compliance	Value Added (1-5)

Table 2 — Author's Requirement's Assessment Process

Waivers

Waivers within the context of this paper include all exceptions to a requirement to comprise deviations, variances, exemptions, non-compliances and the like. Waivers imply a risk change based on a pre-agreed requirement not being met along with an attached assessment to the waiver justifying the management decision to grant the waiver. A misleading belief is that a risk is always increased when a requirement is waived. This belief is further convoluted by the fact that a residual risk is usually present even with full compliance to the requirement. Typically a set of requirements in a requirements document is signed by a manager. From a risk management point of view, this manager's signature means that the manager accepted the residual risk associated with a system or process when in full compliance with the requirements document. Unfortunately, each of the requirements within the requirements document rarely, if ever, are analyzed for the elements (technical basis, verifiability, and residual risk) listed in section above to establish a baseline risk. Therefore, typically the first time a requirement is analyzed and risk noted is when a waiver is requested. Then the speculated change in risk is compared with the new risk associated with waived requirement. Normally the waived requirement is not simply ignored but many countermeasures are established and implemented to control the risk associated with the waived requirement.

An example of a safety variance process is one used by NASA's Kennedy Space Center, KDP-KSC-P-3614, at Figure 1. The waiver form associated with this process is at Figure 2. The very process for generating a waiver is a microcosm of a risk management process from a safety point of view. Options are identified (Block 15), hazard controls identified (Blocks 16-17), risk assessed (Blocks 18-21), Opportunity for dissent (Block 23), and residual risk acceptance (Blocks 26 and 28). Historically, the Department of the Army Safety Center established its safety risk management process using a waiver format as its outline in 1984 – a process still in place today.

Source Selection Board Process

The safety engineer contributes through the technical panel or Technical Evaluation Panel (TEP). The TEP evaluates the individual proposals, makes recommendations to the chairperson regarding clarification and deficiencies and assist the contracting officer during negotiations and discussions. The safety engineer is expected to score the safety requirements for each of the contract proposals in accordance with procedures established in the Request for Proposal (RFP). Engage the scoring process assuming the non-winners will file an unfairness compliant (i.e. protest). Therefore, insure your scoring criteria are fair, objective with all results well documented and defendable. A cardinal rule when evaluating technical proposals is that evaluation factors and significant subfactors and relative weights as stated in the RFP must be strictly adhered to – and not added to or varied from – in conducting the evaluation process. Do not presume the meaning of any part of a proposal that is not clear on its own terms and do not seek additional clarification from offerors on your own. A narrative justification accompanies each of your scores in order to not confuse the scoring of several proposals which you may have to defend weeks after you complete your scoring process during debriefings to unsuccessful offerors. Dissenting opinion is useful in scoring package when consensus of panel members can not be reached. Note: All documents created in the source board process may be released if formal litigation is pursued by any of the offerors.

Bidding or costing the requirement.

Contractors focus on requirements that impact schedule or budget. Examples of attention getting requirements may be a deliverable report or a design feature. During the source board process, the safety engineer should recruit a colleague and both should bid the set of safety requirements as if they were the contractor bidding on the RFP. Comparing both bids and when the variance between both individuals exceeds a predetermined amount, implication is that the requirement needs rework in order to be biddable by a contractor. A checklist of things <u>not</u> to do provided below may help in requirement generation.

- Performance specified at the subsystem or component level when it could be more appropriately specified at a higher level; e.g., the reliability of the system or vehicle should be specified instead of specific components within the system.

- Requirements not measurable or verifiable.

- Statements constraining the solution to a single solution; e.g., "shall be fabricated from composite material."

- Orphan requirements; i.e., requirement statements that are not traceable to a specific performance or verification requirement statement in the specification.

- Requirement statements not appropriate for an effort in this phase of development or production.

- Specifications relying solely on directives to define performance, not the mission requirements.

- Citing standards and processes when performance standards can be developed.

- Citing of mandatory standards without justification.

- Requirements that are vague (e.g., "in accordance with commercial practices" in lieu of citing a commercial standard).

Summary

- A risk assessment process and a waiver process are based on similar or identical logic.

- Full documentation of requirement rationale including any dissent is useful to those considering use of the requirement in future programs.

- Requirements that can not be verified often result in troublesome problems.

Biography

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Ronnie Goodin has 31 years of system safety and industrial safety engineering experience with both DOD and NASA.

BS Aerospace Engineering from Mississippi State University
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10 years in system safety with the Department of the Army; time split between the Army Aviation Command and the Army Safety Center

21 years with NASA,
    NASA HQ: 1 year
    KSC: 3 years in payloads (operations)
        9 years in payload safety
        2 year in the Industrial Safety Engineering Branch
        4 years in Shuttle Program Safety
        2 year safety support of Engineering Development (Current)

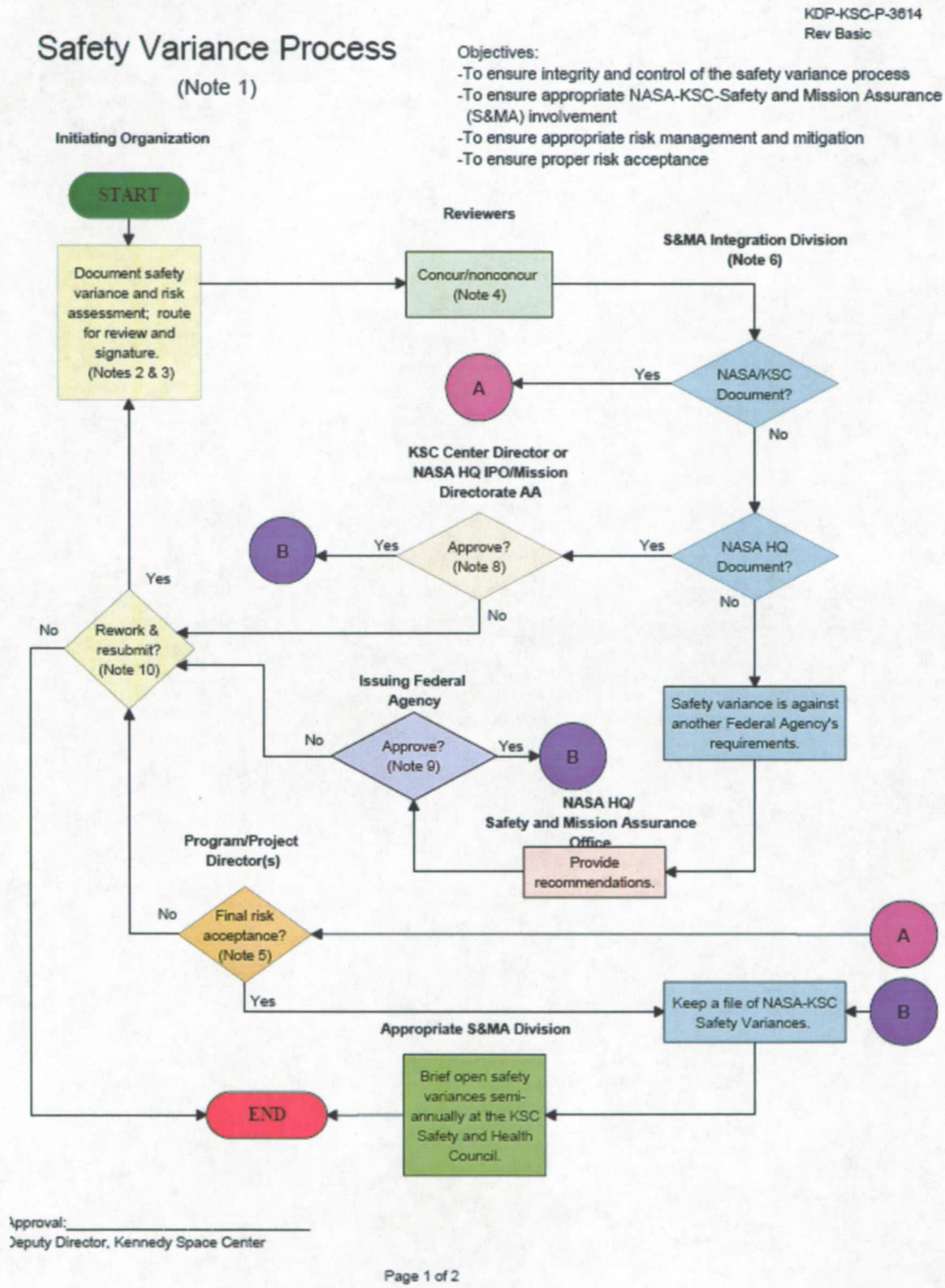

Figure 1 — Kennedy Space Center Variance Process

KDP-KSC-F-3614
Rev. BASIC

KSC SAFETY VARIANCE REQUEST				NASA Control Number KSC-____-___
1. Date of Request	2. Duration (Not to Exceed 1 Year) From To		3. Variance Type (Circle One) Deviation Waiver	
4. Requesting Organization (Enter Company Name)			5. Location of Variance	
6. Document and Section (Unmet Requirement)			7. NASA Program (Select One) ☐ Shuttle ☐ Payloads ☐ ELV ☐ SE&T ☐ Institutional ☐ Space Station ☐ Other	
8. Specify Mission Number			10. Safety Program (Select One) ☐ Explosives, Propellants & Pyrotechnics ☐ Lifting Devices & Equipment ☐ Lightning & Grounding ☐ Pressure Vessels ☐ N/A	
9. Specify Mission/Project Name				
11. Will this activity expose NASA Personnel to hazardous conditions? If YES, contact AFGE Local 513. ☐ Yes ☐ No				
12. Is Procedural Change Required? ☐ Yes ☐ No		13. Specify Procedure		
14. What is the specific requirement(s) which cannot be met (including document and section reference)?				
15. What is the rationale for not meeting the requirement(s), what other options were considered, and what was the rationale used to disposition/discard these options?				
16. Have any design features or procedural controls been eliminated or compromised which would affect the safe operation of the system/operation?				
17. What additional measures or controls have been taken to minimize risk to personnel, facilities or flight hardware, thus ensuring a safe operation in lieu of the requirement?				
18. How has the number of people exposed to the potential hazard been minimized?				

Figure 2 — Kennedy Space Center Variance Request Form

KSC SAFETY VARIANCE REQUEST				NASA Control Number KSC-____-___
19. How has the amount of hardware exposed to the hazard been minimized?				
20. What are the risks associated with failure to meet the requirement(s)? What are the risks associated with not approving this variance (i.e., is there an increased risk if the requirement must be met)?				
21. What is the likelihood of occurrence of a mishap with the identified controls in-place, and what are the consequences should the controls fail or a mishap occur?				
22. What is the plan for ensuring future compliance or partial compliance, thereby eliminating the need for future variances?				
23. Comments and/or Rationale for Disapproval:				

ORGANIZATION		SIGNATURE/DATE	MAIL CODE	PHONE
24. Initiator	Approval Level (Circle One)			
System Engineer	Approval Yes No N/A			
Safety Professional	Approval Yes No N/A			
S&MA Mgr	Approval Yes No N/A			
Other (Optional)	Approval Yes No N/A			
Other (Optional)	Approval Yes No N/A			
25. NASA/KSC				
System Engineer	Concurrence Yes No N/A			
Safety Program Mgr	Concurrence Yes No N/A			
S&MA Div Chief	Concurrence Yes No N/A			
Chair, Ground Risk Review Panel (GRRP)	Concurrence Yes No N/A			
Other (Optional)	Concurrence Yes No N/A			
26. Program Director	Acceptance Yes No N/A			
27. Director of S&MA	Concurrence Yes No N/A			
28 Center Director	Acceptance Yes No N/A			