Prioritizing and Managing Technology Needs to Meet River Protection Project Mission Objectives – 16462

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ABSTRACT

Over 56 million gallons of radioactive waste are stored in 177 large underground tanks at the Hanford Site, located in southeastern Washington State. This nuclear waste resulted from plutonium production for the nation's nuclear defense program. The River Protection Project (RPP) mission is to:

- Safeguard and safely manage waste stored in the Hanford tanks
- Treat the waste using the Waste Treatment and Immobilization Plant (WTP)
- Ensure safe disposition of the waste to protect the Columbia River and the environment.

Each aspect of the mission requires some application of technology in order to meet the mission objectives. The RPP Technology Roadmap document presents a comprehensive, integrated assessment of the technology-related advances needed to ensure successful completion of the Hanford tank waste cleanup mission. This paper describes the development of the RPP Technology Roadmap, summarizes its content, describes integration and collaboration with the Department of Energy's national laboratories to support the work identified, and defines how priorities were identified to ensure near-term RPP mission commitments can be accomplished while preserving the longer term technology development elements necessary for mission completion.

The Challenge – Managing a wide variety of technology needs that involve multiple organizations, contractors, and national laboratories presents additional challenges when funding constraints are factored in. A process was needed to ensure the technology needs supporting near term mission priorities were appropriately identified, prioritized, and supported through the fiscal year planning process. Additionally, the national laboratory resources necessary to support many of the technologies require coordination to ensure the most appropriate resources are applied at the appropriate level without duplication or contradiction of effort.

The Solution – The RPP Technology Roadmap was developed with the primary purposes to:

- Identify technology related items needed to support or enhance the River Protection Project (RPP) mission
- Prioritize technology needs to support fiscal year planning processes
- Organize National laboratory support of the RPP mission and communicate needs to the participating contractors

The Technology Roadmap is consistent with Department of Energy (DOE) Hanford mission priorities and is also in alignment with other Hanford Site technical initiatives and policy and planning documents. The Technology Roadmap highlights the current estimated technology needs and identifies where planning shortfalls exist and where national laboratory participation is needed to support mission success. This information assists fiscal year planning and national laboratory contracting processes to ensure that technology needs are supported. In addition to supporting the RPP baseline mission, the Technology Roadmap provides a basis for strategic planning by identifying opportunities to use technology solutions to enhance mission efficiency.

This waste management paper describes the innovative and collaborative processes used to develop, validate, and communicate the results so the project owners and the national laboratories can most effectively plan work scope and resources. A discussion of the following processes is included:

- Technology needs and task owner identification
- Functional area grouping and area lead identification
- Needs prioritization
- High priority needs ranking (including validation)
- Results compilation and planning gap identification
- Results presentation by project and functional area
- National laboratory coordination and collaboration

Application – The process used to develop the RPP technology roadmap is applicable to any site where multiple national laboratories and contractors are involved in identifying and implementing technology based solutions. This process is also applicable to the DOE HQ role to provide prioritization and coordination of the nationwide technology development activities.

INTRODUCTION

The Hanford Site produced plutonium for the nation's defense program beginning with the Manhattan Project and continuing during the Cold War. Over 56 million gallons of wastes originally generated from nuclear materials production are currently stored in underground tanks located on the Hanford Site's Central Plateau. Some of these underground storage tanks are over 70 years old. The River Protect Project (RPP) mission is to continue to safely store and manage the tank waste, but also to facilitate its safe retrieval from the tanks and delivery to the WTP for treatment and immobilization. The immobilized wasteforms will be disposed and the storage tanks and waste management areas closed. The ultimate goal of the RPP mission is to ensure protection of the public, the Columbia River and surrounding environment.

There are many challenges facing the RPP mission, for example: aging site infrastructure, limited double-shell tank (DST)[1] space, delays in WTP availability,

[1] *There are 28 DSTs at the Hanford Site. There are 149 single-shell tanks (SST). The DSTs are newer and are the tanks that accept waste retrieved from the SSTs. The DSTs are also the tanks that WTP will accept waste feed from.*

legal obligations that drive mission priorities. Washington River Protection Solutions (WRPS), the Hanford Site Tank Operations Contractor (TOC), developed a technology roadmap [1] to assist with identifying technical challenges; determining mission priorities as a function of timeframe, risk, function and cost; and proposing technology solutions.

TECHNOLOGY ROADMAP DEVELOPMENT

The Technology Roadmap focuses on identifying and connecting technology needs to high-priority, near-term mission objectives and also considers longer-term gaps and pending programmatic decisions that require technology support. The technology evaluation process involved identifying technology needs, determining the relationship to near-term and long-term mission goals, and then prioritizing them. This process ensured that key needs were addressed to support the RPP mission. To adequately address these challenges, first the technology needs were systematically identified. The overall RPP Mission was generically binned into functional areas as illustrated by Figure 1.

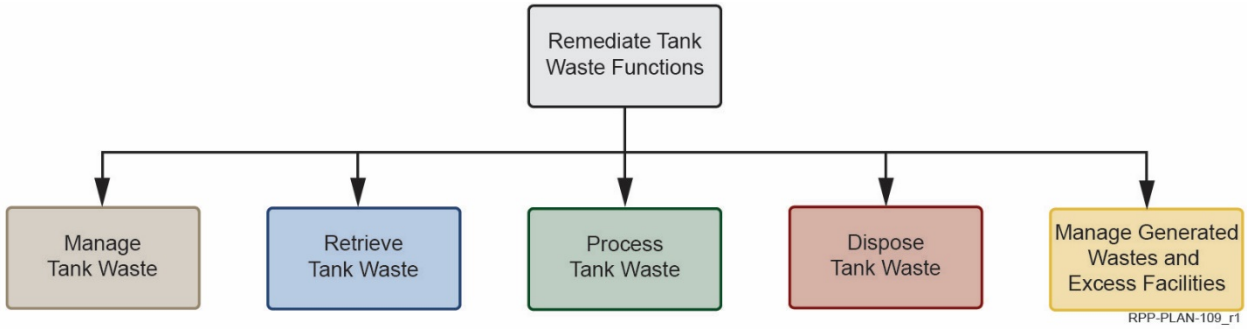


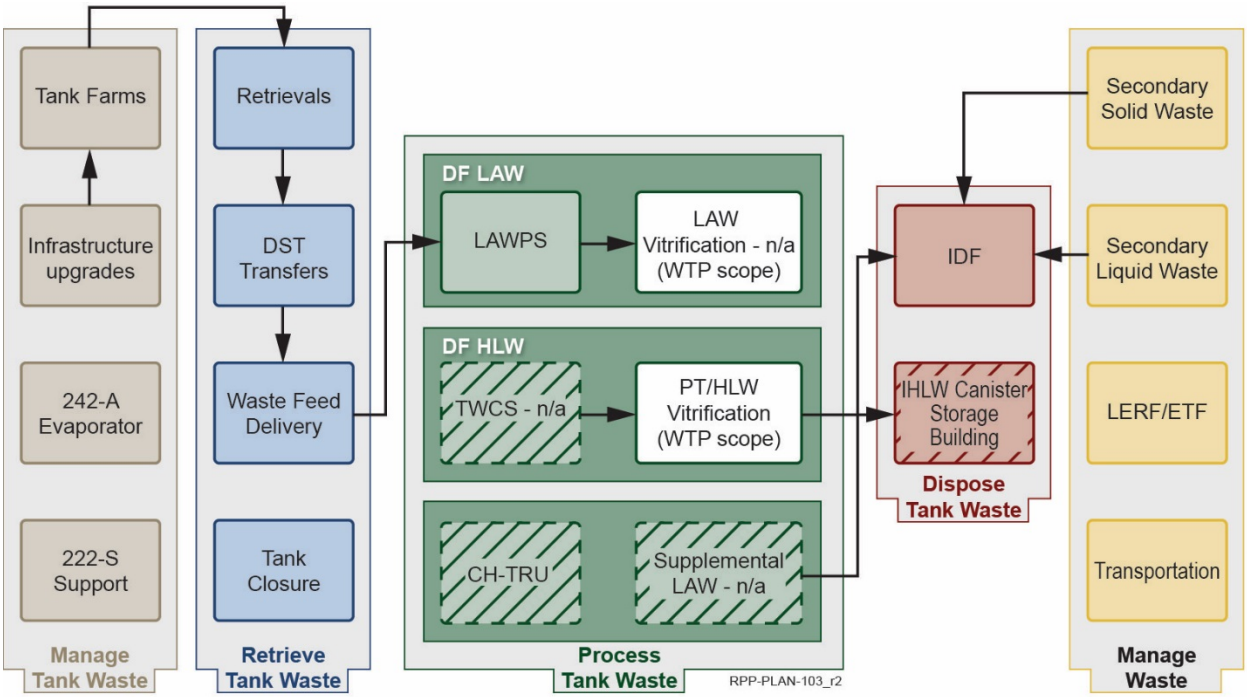
Figure 1 – River Protection Project Mission Functional Areas

Not all of the scope identified in Figure 1 is within the span of control of the Tank Operations Contractor (TOC), e.g. WTP.

Figure 2 provides more detail of the operations, projects and facilities that are part of the TOC scope and are covered by the RPP Technology Roadmap. The hatch marked boxes indicate conceptual scope that has not been authorized yet. The white boxes indicate WTP scope. This framework was used to help organize, sort and prioritize technology needs.

Using

Figure 2 as a guide, subject matter experts for each functional area were identified and requested to provide technology needs input using standardized *pro* forma worksheets. The pro forma worksheet provided a tool for direct comparison of parallel input. The pro forma worksheets include information regarding: technology description, functional area, need, driver, priority, scope and schedule, national laboratory support needs, etc. An overview workshop was held with management representatives from all the various functional areas and follow-on individual workshops were held for each functional area.



CH-TRU	=	contact-handled transuranic.	HLW	=	high-level waste.	LERF	=	Liquid Effluent Retention Facility.
DFLAW	=	direct-feed low-activity waste.	IDF	=	Integrated Disposal Facility.	PT	=	pretreatment.
DFHLW	=	direct-feed high-level waste.	IHLW	=	immobilized high-level waste.	TWCS	=	tank waste characterization and staging.
DST	=	double-shell tank.	LAW	=	low-activity waste.	WTP	=	Waste Treatment and Immobilization Plant
ETF	=	Effluent Treatment Facility.	LAWPS	=	low-activity waste pretreatment system.	222-S	=	TOC Laboratory

Figure 2 – Tank Operations Contractor Functional Scope

The points of contact provided pro forma worksheets documenting technology needs within their areas of expertise. In this manner, technology and technology needs identification was provided directly by the personnel most knowledgeable. This information was consolidated and relative priority of individual pro forma input was evaluated and scored by a representative technical council. This process is summarized in Figure 3. In order to consistently prioritize technologies, it was essential to define prioritization criteria and logic.

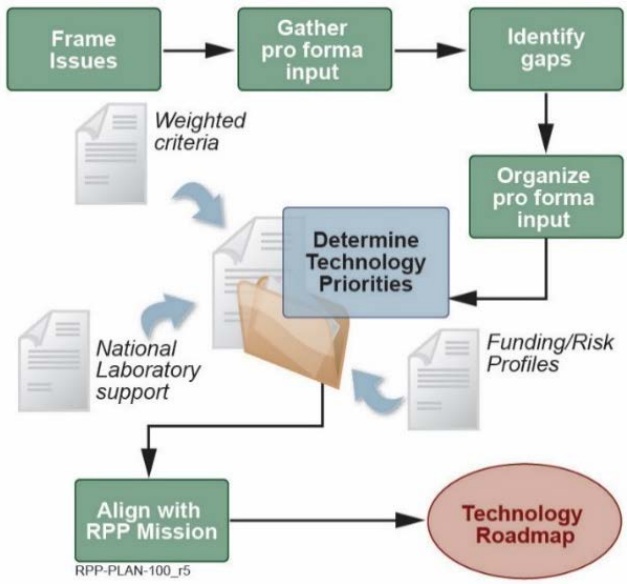


Figure 3 – Technology Roadmap Development methodology

PRIORITIZATION PROCESS

Given limitations of funding and the fact that some tasks require development of predecessor tasks prior to implementation, not all identified technology tasks can be performed concurrently. Therefore, a method to prioritize the various technology actions was established. A council consisting of the

functional area subject matter experts, independent reviewers, and DOE Office of River Protection (ORP) personnel, developed the prioritization criteria and scored the technologies. Figure 4 illustrates the general logic for screening and prioritizing technology actions used by the prioritization council. The prioritization council was comprised of one expert representative from each functional area plus three additional impartial members familiar with the RPP mission scope. The impartial council members represented ORP, the TOC Chief Technology Office (CTO), and One System[2] Strategic Planning. The technologies were first pre-screened against the mission goals outlined by DOE and the key RPP near-term mission priorities (see Figure 4).

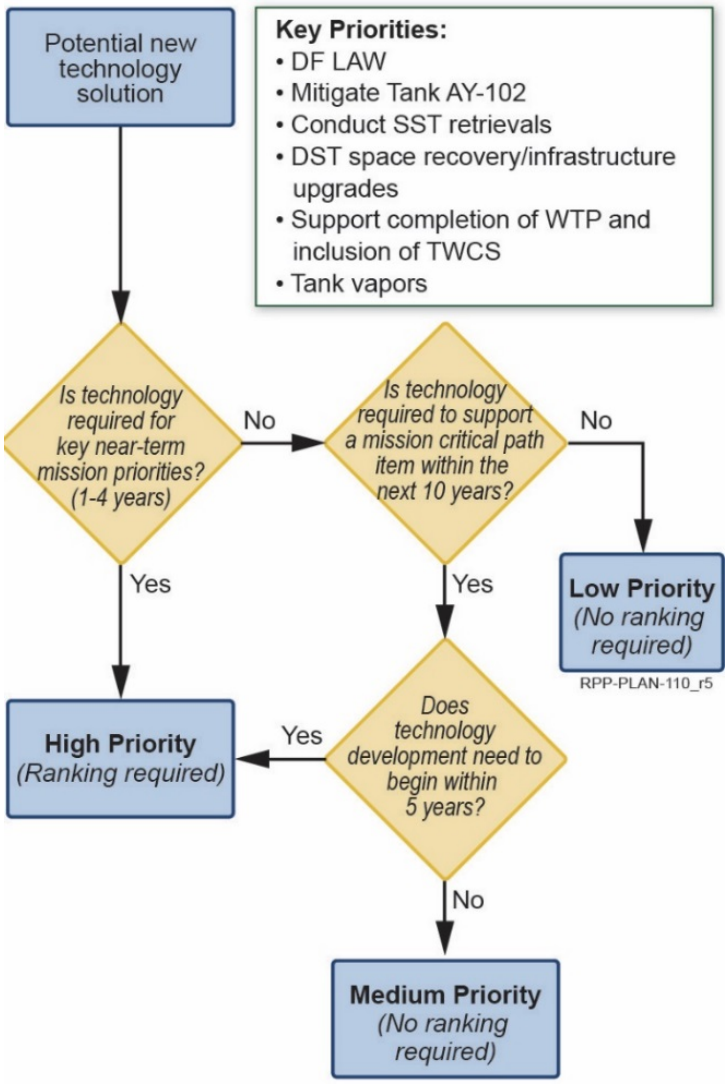


Figure 4 – Mission Driven Technology Activity

The ranking/comparison system accounted for the urgency of the need and the potential benefit of the proposed technology solution. The urgency of a technology need is related to timing, while the benefit of the solution is related to the magnitude of its contribution to overall mission success. Note that routine process operations support is not included as part of the Technology Roadmap. Process technology support activities (e.g., waste qualification programs/glass testing) are ongoing programs that will permanently support operations. The Technology Roadmap will be revised on a regular basis to account for emerging challenges and projectized efforts that require technology maturation and support.

Each pro forma was prescreened against RPP mission priorities (see Figure 4). Only those prescreened "high priority" were brought before the prioritization council. A set of evaluation criteria and a scoring protocol were defined

[2] *One System is an organization comprised of TOC and WTP personnel chartered to bridge the gap between the TOC mission and the WTP mission. Both TOC and WTP contribute to the overall RPP Mission.*

to determine relative priority for purposes of guiding out-year technology scope decisions. Results were validated by the functional area leads.

The evaluation criteria were divided into high, medium, and low weighting categories as reflected in TABLE I. As part of the overall priority evaluation, additional incremental scoring based on the level and extent of the impact for each criterion was also taken into account. The final priority value was scored according to the summation of the weighted high, medium, and low attributes. This process is summarized in TABLE I.

The ranking process resulted in a whole number ranking for each item. Some items were assigned the same whole number priority. To further discriminate between the tie scores, an evaluation of the four primary categories (safety, DOE commitment, risk, and impact) was performed, and a sub-ranking process was applied to further differentiate rank according to category weight by adding a relative decimal value. For example, the highest weighted criteria (safety) will account for the highest value for determining the decimal value. This process was continued throughout all the category weightings. If tie scores remained, judgment was deferred to the council to discriminate between the equal items. Sub-ranking is identified by the decimal point rankings within each whole number rank (e.g., 5.0 is considered a slightly higher rank than 5.1).

TABLE I – Scoring Protocols for Priority Determination

Evaluation criteria	High (3x weight)		Medium (2x weight)			Low (1x weight)	
	Safety	DOE commitment	Risk mitigation	Schedule impact	DOE scope benefit	Technology impact	Regulatory impact
Gauge for relative criteria score	**Reduce safety risk?**	**Contribute to DOE commitment completion?**	**Reduce RPP risk?**	**Impact near term schedule?**	**Benefit RPP mission scope?**	**Multiple applications?**	**New regulatory action?**
3	Yes	Needed for legal requirement	Supports new mitigation	Needed to maintain or recover schedule	Life-cycle cost savings >$5B	Benefits RPP plus other Hanford projects	No, within scope
2	Maybe	Needed for public commitment	Supports known mitigation	Needed to accelerate schedule	Life-cycle cost savings >$1B but <$5B	Benefits RPP plus other DOE sites	N/A
1	No	No direct impact	Acceptable risk	No impact	Life-cycle cost savings <$1B	Project-specific	Yes, requires formal regulatory modifications
Total = 3∑(high criteria scores) + 2∑(medium criteria scores) + 1∑(low criteria scores)							

DOE = U.S. Department of Energy. RPP = River Protection Project.

Technology Needs

TABLE II presents a summary of the high-priority needs that were scored by the prioritization council, further subdivided by overall project area. These results were obtained as part of the Technology Roadmap development process and grouped to be consistent with project planning. Technology needs are presented in two main categories: technology selection and development needs, and technology maturation needs. The ranking results from the prioritization process and a planned path forward to describe the next steps to address technology maturation needs are also provided. The [#.#] in the Technology Maturation column of TABLE II represents the overall ranking within the high-priority technologies.

For purposes of this evaluation, technology selection refers to the identification of new technologies that are not included in current baseline designs or project planning. This is typically associated with basic research and feasibility studies commonly associated with technical readiness levels (TRL) 1, 2, or 3. TRL is a standardized measure of technology maturity and is defined by DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets* [2] and further described in the U.S DOE Office of Environmental Management (EM), *Technology Readiness Assessment (TRA) / Technology Maturation Plan (TMP) Process Implementation Guide* [3]. Overall technology maturation refers to the advancement and progression of selected technologies, culminating with the technology readiness level appropriate for system startup and operations (i.e., TRL 9).

TABLE II – Prioritized Project Technology Needs

Key project	Technology selection	Technology maturation	Path forward
Vapor solutions	None	[1.0] Vapor abatement [2.0] Surrogate method for vapors detection [3.0] Vapor monitoring/detection [3.2] Headspace particulate sampling [5.0] Headspace vapor sampling [5.1] Chemical plating from vapors [5.2] Toxicological studies [13.1] MOV testing [14.0] 222-S Laboratory method development	Procurement, testing, and implementation
LAWPS	None	[1.1] Flammable gas generation rate evaluation [4.0] IX eluate neutralization [6.1] Integrated system functionality [6.2] IX equipment maturation [6.3] Crossflow filtration equipment maturation [6.4] IX resin replacement and disposal	Technology development and maturation per EM TRA/TMP Process Implementation Guide
Secondary liquid waste/ IDF PA	[11.2] Immobilized waste form performance	[3.1] Improved grout formulation [5.3] LAW glass performance	IDF PA development and support

Key project	Technology selection	Technology maturation	Path forward
Retrieval	[4.3] Mechanical waste gathering systems	[4.1] Next generation slurry pump [4.2] Rotary core riser cutter system [6.0] Tank farms remote inspections [10.2] Radioactive waste monitoring system [11.3] Improved radiation resistant hoses [8.3] Direct push core sampler system [12.0] Remote temperature monitoring systems	Develop infrastructure improvements and prepare for A/AX Farm tank retrievals
Closure	None	[6.5] Highly flowable grout	Testing to facilitate tank closure methods
Tank integrity	[14.1] Under-tank robotic crawler inspection	[9.0] Improved LOW data system [10.0] Upgraded DST video camera system [10.1] Guided wave solids measurement system [11.0] Automated DST annulus camera system [13.0] Upgraded DST still camera system	Acquire, test, and install
Mission improvement	[7.1] Low-temperature waste form development	[8.1] ILAW cooling [10.3] LAWPS recycle reduction [11.1] New waste tank design [11.2] Supplemental LAW immobilization [15.0] Improved analytical task redundancy	Flowsheet optimization

DST = double-shell tank.
IDF = Integrated Disposal Facility.
ILAW = immobilized low-activity waste.
IX = ion exchange.
LAW = low-activity waste.
LAWPS = low-activity waste pretreatment system.
LOW = liquid observation well.
MOV = motor-operated valves.
PA = performance assessment.

National Laboratory Roles

Some of the high-priority items identified in the Technology Roadmap involve support from the national laboratories. The development of technology is often relegated to directed national laboratory work. This work is identified based on technology needs to fill gaps and buy-down risk. The WRPS CTO has established a work management program for tracking and reporting national laboratory work to One System upper management and ORP. All national laboratory work is routed through the CTO, with work performance reported monthly and used to produce standardized metrics for cost and schedule. This management system enables accurate tracking of cost and schedule performance, provides familiarity with the individual national laboratory technical strengths, and establishes relationships and points of contact. All of these interactions improve communications and are considered when directing new work.

The national laboratories can provide a combination of technical expertise and analytical capabilities and services that are not available within WRPS or WTP. In some instances, the national laboratories are also called on to spearhead technical review groups or provide nationally recognized experts to consult regarding specific problems. The national laboratories are also engaged to provide lessons learned regarding cross-cutting work (e.g., waste feed certification or tank closure). The

Technology Roadmap will assist with out-year planning and effective allocation of technology work to the national laboratories, as appropriate.

Planning Tool

The cost and schedule information from the pro forma sheets can be combined with the prioritization ranking to develop a time phased funding status of technology needs on an individual or a companywide level. As an example, Figure 5 identifies high priority item planning gaps where additional baseline scope is needed to meet estimated needs. For purposes of this discussion, planned scope includes activities that are part of the Tank Operations Contract or ORP life-cycle planning baseline. Estimated need includes all technology scope identified on the pro forma worksheets regardless of associated planning status. This planning gap information is useful for making fiscal year planning decisions.

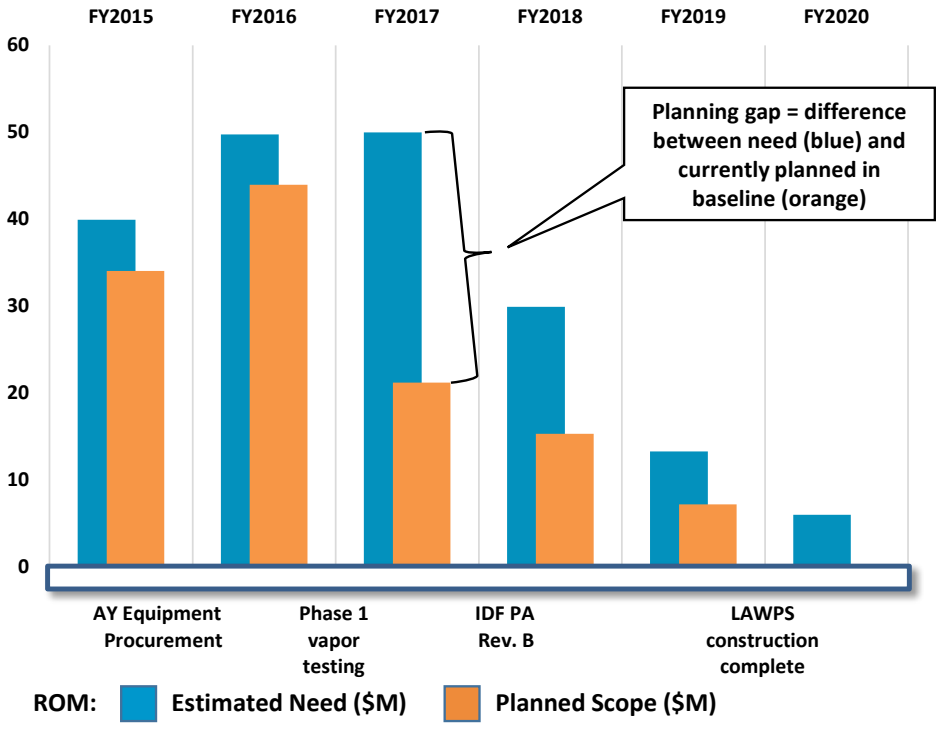


Figure 5 – High Priority Planning Gaps

This basic planning information can also be displayed for each level of priority or can be used to identify which technology items require national laboratory support. Figure 6 presents an example of how planning gaps can be identified for each priority level on a fiscal year basis. The fact that the documented needs tail off after FY17 reveals that continued out-year planning is needed. This highlights one of the primary functions of the Technology Roadmap; to identify and integrate needed technologies as a function of time to proactively identify and plan for both forecasted and emerging needs.

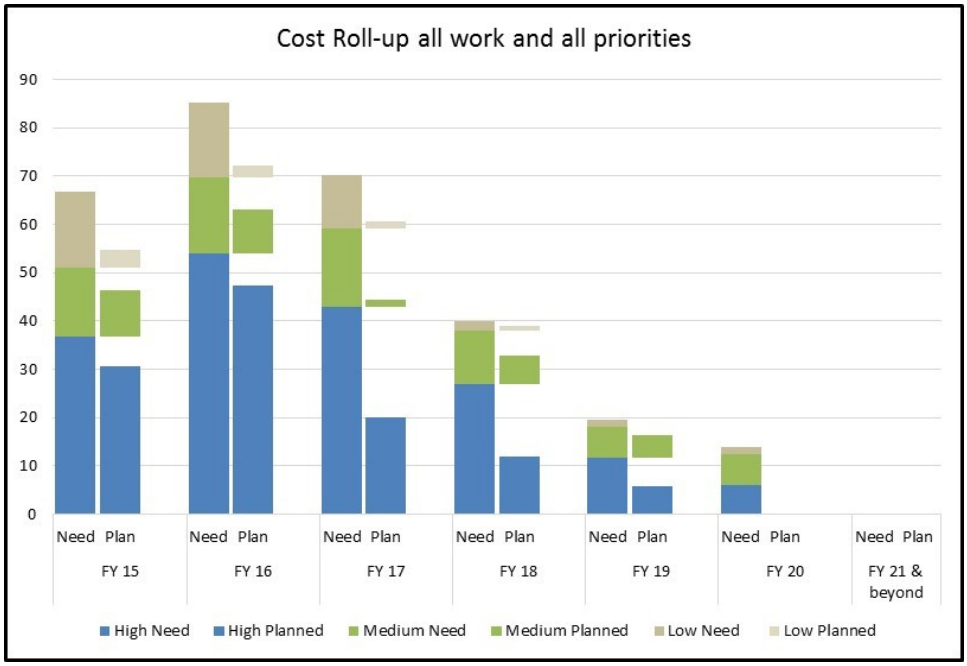


Figure 6 – Comprehensive Technology Roadmap Activity Costs as a Function of Time

CONCLUSIONS

ORP is responsible for managing and completing the RPP mission, which comprises both the Hanford Site tank farms operations and the WTP. The life-cycle cost of tank waste cleanup is strongly influenced by the WTP operating duration. Each year the RPP mission continues beyond its forecasted end date costs taxpayers approximately $1 billion in today's dollars. Therefore, there is a significant life-cycle cost incentive to complete tank waste treatment processing at the earliest practicable date.

The Technology Roadmap was developed in a systematic manner to facilitate sound strategic, programmatic, and fiscal planning regarding existing technology gaps in the RPP mission. Based on pro forma input from expert personnel, the technology needs were tied to the actual projects. As the RPP mission consists of many interwoven, interdependent unit operations, a technology gap or need in an upstream unit operation can cause a ripple effect of downstream impacts throughout many functional areas of the mission.

A prioritization process was used to differentiate high-priority issues from medium- or low-priority issues, by applying logic based on: need, urgency, and stakeholder requirements. A prioritization council evaluated prescreened high-priority technology activities. Weighting criteria were applied to determine relative ranking among the high-priority items.

The Technology Roadmap highlights the current estimated technology needs and identifies where planning shortfalls exist and where national laboratory participation is needed. This information is intended to support the fiscal year planning and national laboratory contracting processes to ensure that technology needs are supported as necessary to complete the RPP mission. In addition to supporting the RPP baseline mission, the Technology Roadmap provides a basis for strategic planning by identifying opportunities to use technology solutions to enhance mission efficiency. The Technology Roadmap will be updated on a regular basis to reflect changes to mission risks and technology needs.

REFERENCES

[1]. RPP-PLAN-43988, *River Protection Project Technology Roadmap*, Revision 1, Washington River Protection Solutions, (2015).

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