Environmental Management Advisory Board

Tank Waste Subcommittee (EM-TWS)

SUMMARY REPORT - HANFORD WASTE TREATMENT PLANT

SEPTEMBER 15, 2010

AGENDA

- Charge to the EM-TWS
- EM-TWS Membership
- Charge 1
  - Bottom Line
  - Background
  - Review Process
  - Overview
  - Recommendations
  - Pulse Jet Mixing
- Charge 2
  - Overview
  - Observations
  - Recommendations
- Charge 3
  - Overview
  - Observations
  - Recommendations
- Owner/Operator Group Initial Tasks
- Interim Commissioning Organizational Structure (based on Science model)
- Summary

EM-TWS CHARGE

Charge 1: Verification of closure of Waste Treatment and Immobilization Plant (WTP) External Flowsheet Review Team (EFRT) issues.

The Subcommittee should verify that technical resolutions for the 28 issues identified by the EFRT are being or have been successfully implemented to ensure that engineering and design activities can be completed to reduce WTP project risk.

Charge 2: WTP Technical Design Review

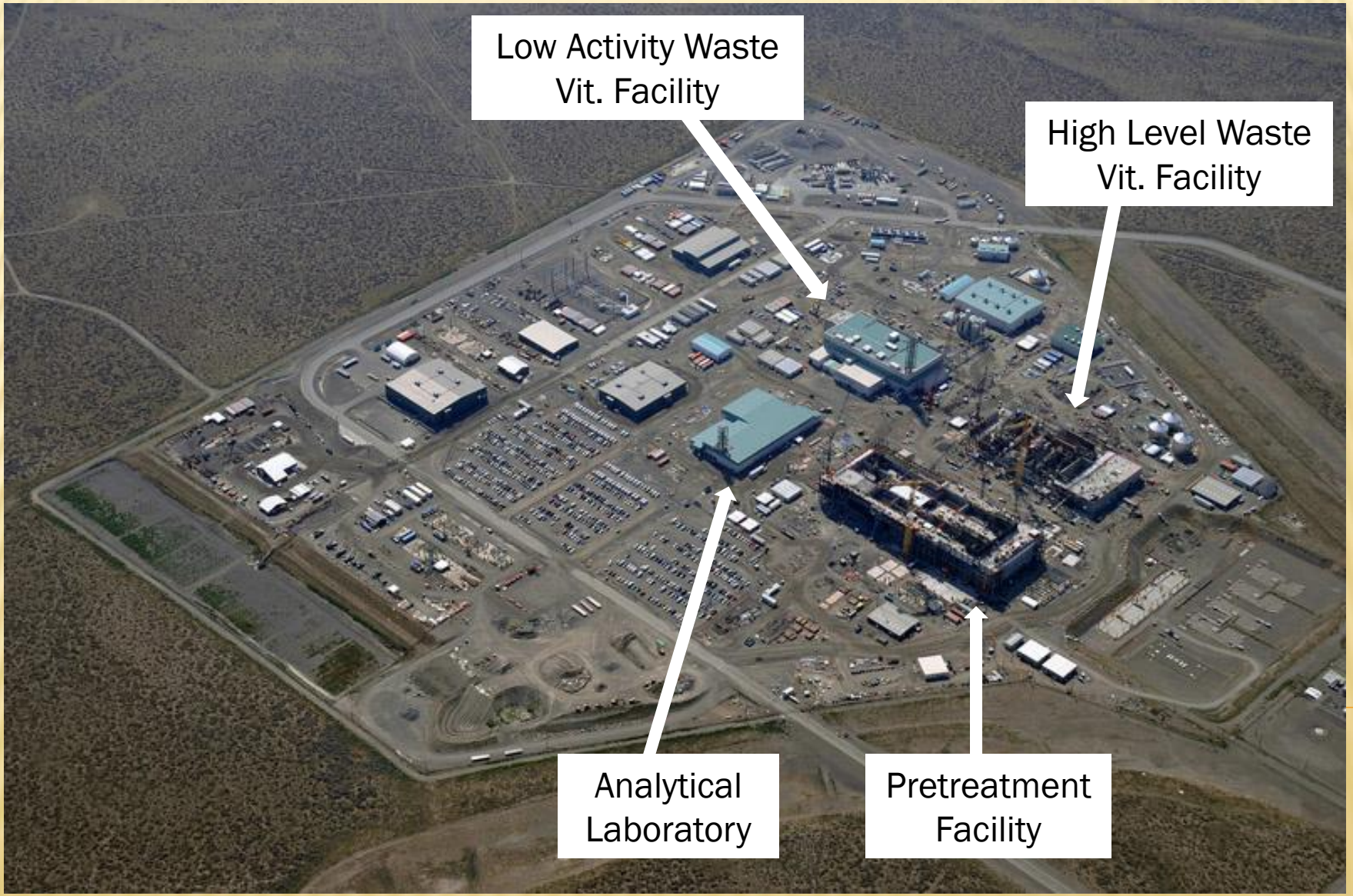
The WTP is at approximately 80% design completion. The Subcommittee should perform a systems-based review of the design against the contract functional requirements.

The Subcommittee should address and provide advice on the following areas related to the design: 1) technical risks have been adequately addressed in the design, and 2) design is sufficiently mature to allow proceeding with needed procurements and construction activities to meet WTP requirements.

Charge 3: WTP Potential Improvements

The WTP will treat 53 million gallons of highly radioactive waste in 177 underground tanks at Hanford over several decades. Therefore, the Committee should consider any technical improvements that could result in a net reduction in the life cycle cost and schedule of the tank waste cleanup provided that the improvements do not have an adverse impact on the WTP Total Project Cost or project completion date.

WTP CONSTRUCTION SITE, JULY 2010



EM-TWS MEMBERS

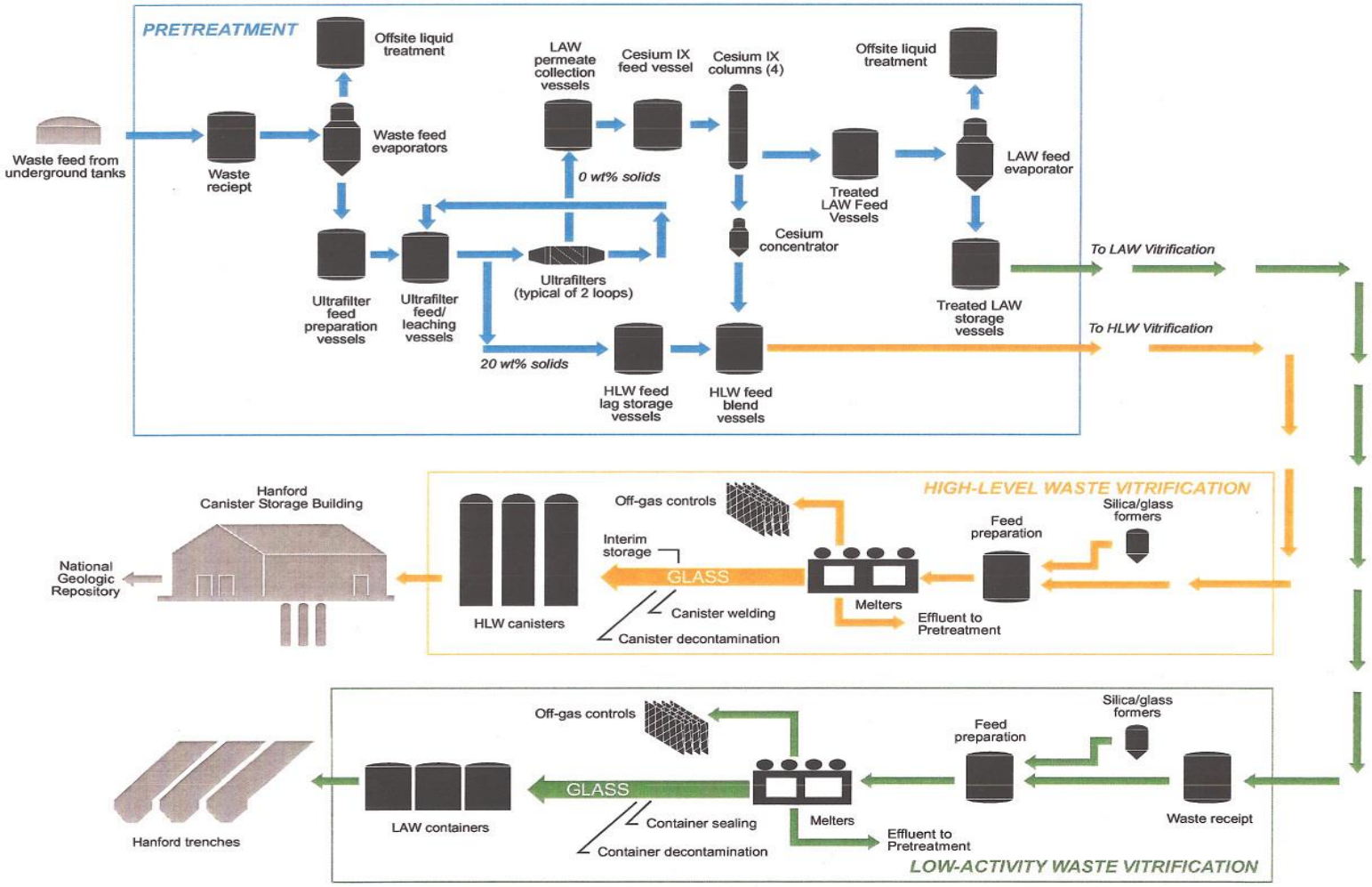
- Dennis Ferrigno – Co-chair and Member
- Larry Papay – Co-chair and Member
- Kevin Brown – Member
- Ed Lahoda – Member
- Alan Leviton – Member
- Bernie Meyers – Member
- David Shuh – Member
- Jim Stevens – Member
- Barry Naft – Technical Support
- Herb Sutter – Technical Support
- Steve Agnew – Technical Support
- Terri Lamb – DOE Designated Federal Official
- Pam Logan – Deputy Designated Federal Official
- Elaine Merchant – Technical Editing

WTP BACKGROUND

- First-of-a-kind plant
- Four integrated facilities plus support infrastructure
- More concrete, steel, and piping than a large nuclear power plant
- British and U.S. nuclear waste management technologies
- Chemical plant processing nuclear materials

WTP BACKGROUND (CONT'D.)

WTP Process Flow



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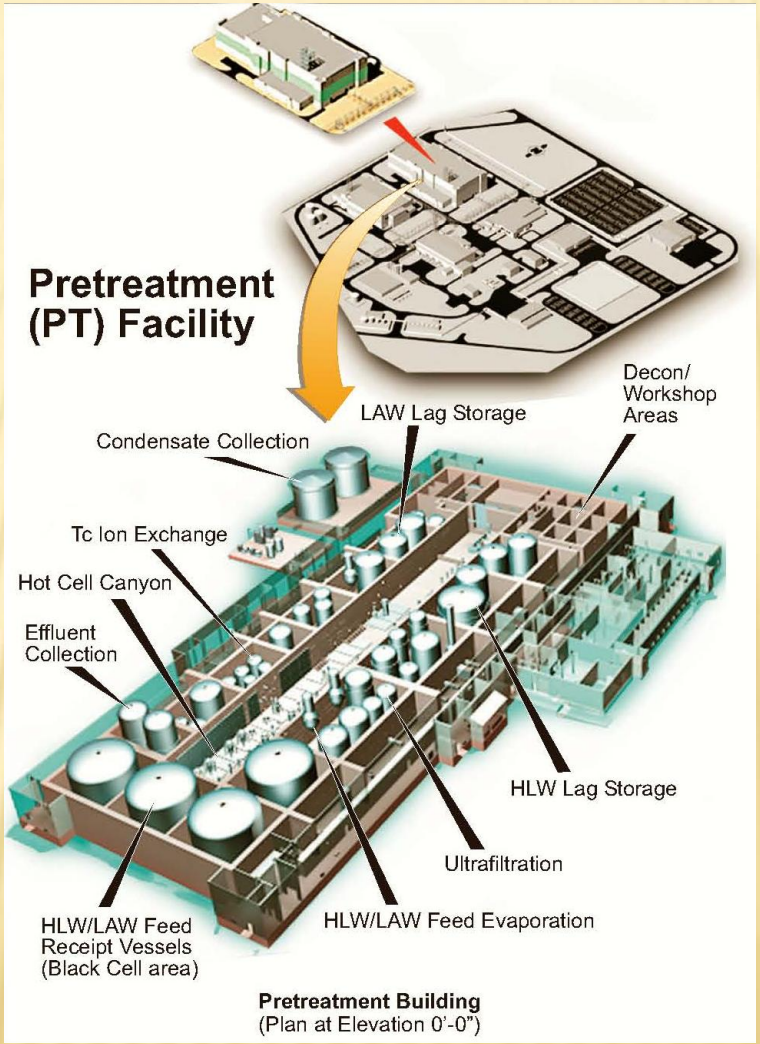

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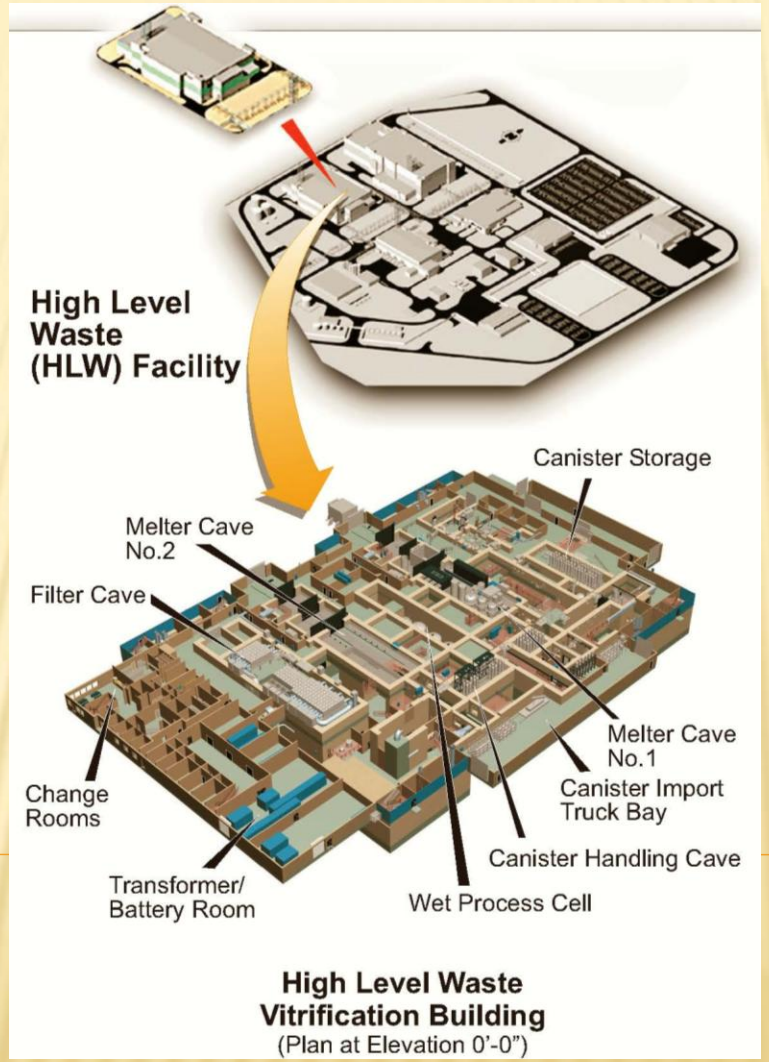

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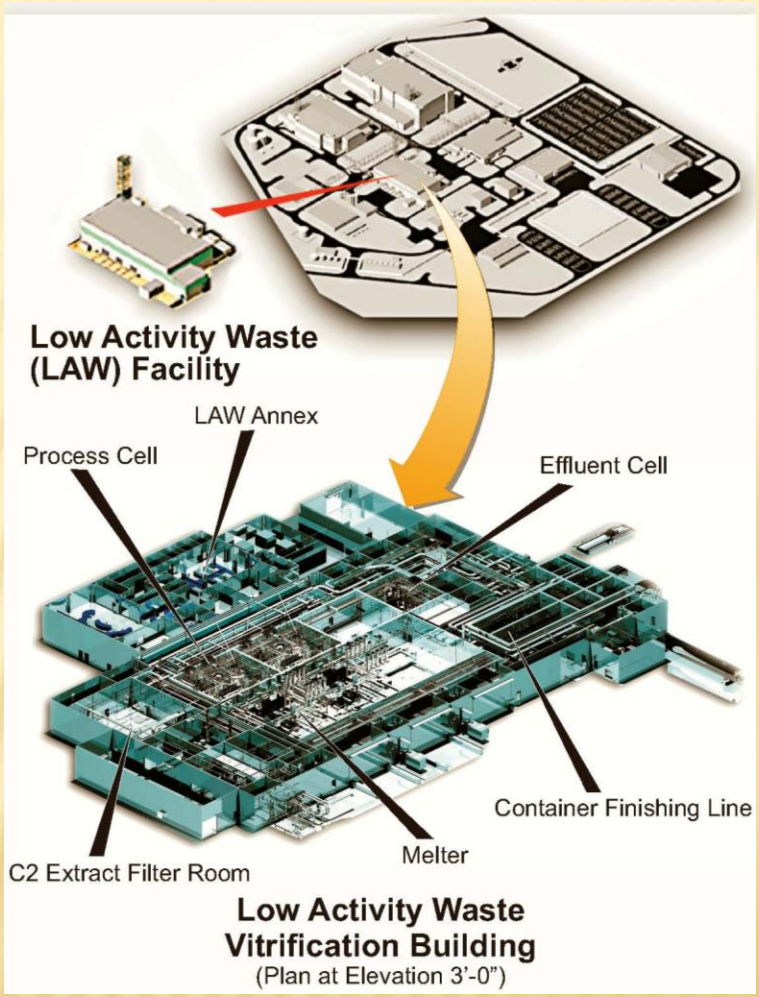
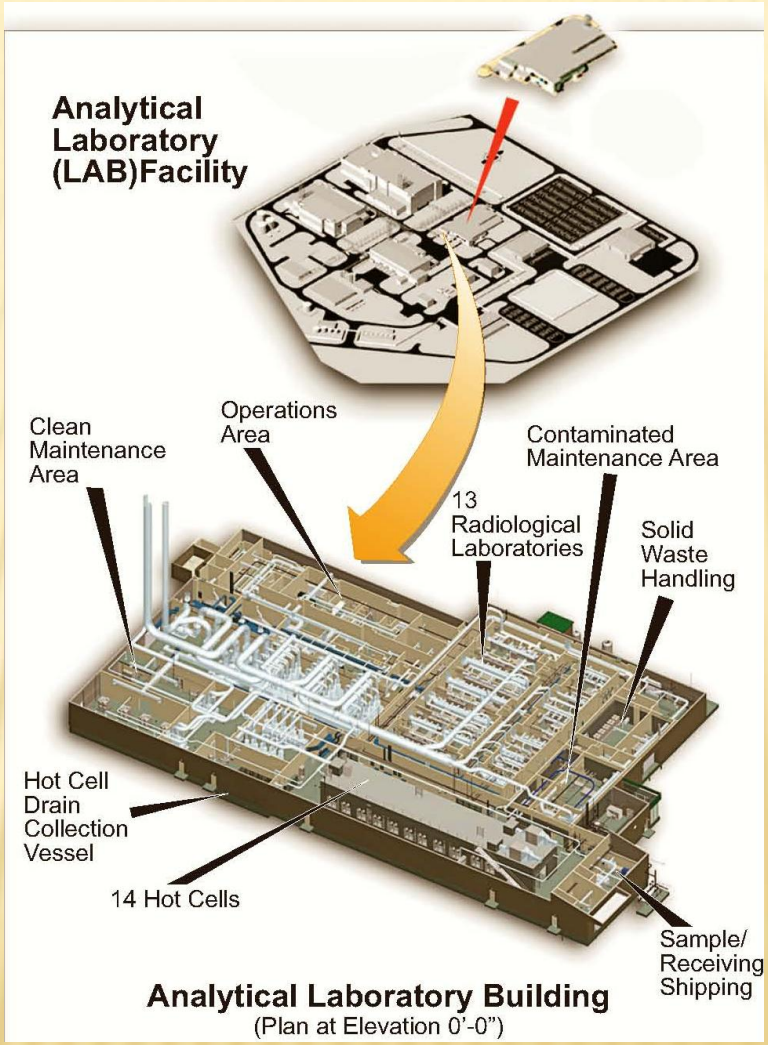


WTP BACKGROUND (CONT'D.)



WTP BACKGROUND

- Project in 10th year
- Engineering > 81 %
- Construction > 50%
- WTP executing Engineering, Procurement, and Construction (EPC)

Facility	Percent Complete		
	Eng.	Proc.	Const.
High-Level Waste	85	58	29
Low-Activity Waste	92	79	62
Pretreatment	81	44	32
Laboratory	82	71	66
Balance of Facilities	82	44	59

- Tank Farms to forward materials (waste) from tanks
- Commissioning in 2019
- Plant mission to be complete in 2047

MAJOR RIVER PROTECTION PROJECT MILESTONES

Tank Farms	
9/30/2014	Complete C farm retrievals
6/30/2019	Close C farm
9/30/2022	Complete 9 tank retrievals beyond C farm
12/31/2040	Retrieve waste from all Single Shell Tanks
1/31/2043	Close all Single Shell Tanks
12/31/2047	Treat all waste

Waste Treatment Plant	
12/31/2012	LAB construction substantially complete
12/31/2014	LAW construction substantially complete
5/30/2019	Complete LAW hot commissioning
7/31/2019	Complete HLW hot commissioning
2/28/2019	Complete PT hot commissioning

PROCESS OF THE EM-TWS WTP REVIEW

- Charge Captains
  - Kevin Brown – Charge 1
  - Bernie Meyers – Charge 2
  - Jim Stevens – Charge 3
- Consensus process with teams and whole group
- Data gathering by technical support as well as WTP contractor and DOE staff
- Numerous meetings, briefings, documents, programmatic status reviews
- Closed meetings, permitted under FACA, necessary to meet September 15 deadline

SUMMARY – BOTTOM LINE (CHARGE 1)

Charge 1: Verification of EFRT issue closure

The EM-TWS reviewed the 28 areas of concern identified by the EFRT and concluded that they are adequately closed, and that EPC should continue to completion.

EM-TWS CHARGE 1 OVERVIEW

EFRT Issue	Title	Date Closed
M1	Plugging in Process Piping	02 Mar 09
M2	Mixing Vessel Erosion	10 Oct 09
M3	Inadequate Design of Mixing Systems	**20 Aug 10**
M4	Designed for Commissioning Waste vs. Mission Needs	13 Nov 07
M5	Must Have Feed Pre-Qualification Capability	18 Oct 07
M6 / P4	Process Operating Limits Not Completely Defined/Gelation/Precipitation	08 Dec 08
M7	Inconsistent Long-Term Mission Focus	13 Nov 07
M7a/M7b	Lack of Spare LAW Melter / Lack of Spare High-Level Waste (HLW) Melter	02 Nov 06
M8	Limited Remotability Demonstration	15 Oct 07
M9	Lack of Comprehensive Feed Testing during Commissioning	18 Oct 07
M10	Critical Equipment Purchases	15 Oct 07
M11	Loss of WTP Expertise Base	17 Mar 08
M12	Undemonstrated Leaching Processes / Pretreatment (PT) Facility	29 Sep 09
M13	Inadequate Ultrafilter Surface Area and Flux (PT)	24 Sep 09
M14	Instability of Baseline Ion Exchange (IX) Resin (PT)	18 Oct 07
M15	Availability, Operability, and Maintainability (PT)	15 Apr 08
M16	Misbatching of Melter Feed (LAW Vitrification Facility)	18 Oct 07
M17	Plugging of Film Cooler and Transition Line (LAW Vitrification Facility)	15 Apr 08

EM-TWS CHARGE 1 OVERVIEW (CONT'D.)

EFRT Issue	Title	Date Closed
P1	Undemonstrated Decontamination Factor (PT-Evaporators)	15 Apr 08
P2	Effect of Recycle on Capacity Evaporators (PT-Evaporators)	13 Nov 07
P3	Adequacy of Control Scheme (PT–Evaporators)	12 Dec 06
P5	Inadequate Process Development (PT-IX)	21 Dec 07
P6	Questionable Cross-Contamination Control (PT-IX)	18 Oct 07
P7	Complexity of Valving (PT-Ion Exchange)	17 Mar 08
P8	Effectiveness of Cs-137 Breakthrough Monitoring System (PT-Ion Exchange)	18 Oct 07
P9	Undemonstrated Sampling System (Analytical Laboratory (LAB) and Sampling)	05 Nov 09
P10	Lack of Analysis before Unloading Glass-forming Chemicals in Silos (Balance of Facilities (BOF))	15 Oct 07
P11	Incomplete Process Control Design (Design of Control Systems)	21 Dec 07

EM-TWS CHARGE 1 RECOMMENDATIONS

EFRT Issue	Description	Impact on Commissioning	Additional Concerns	Significant Recommendation
M1	Plugging in Process Piping	The impact of modifying piping specifications on the commissioning cost and schedule	Potential for plugging in WTP lines, especially outside normal operations and the risk of plugging in transfer lines being too high.	**2010-02:** Analyze to identify high-risk lines for plugging, reanalyze current transfer line design to ensure acceptable risk of plugging, consider physical processes for reducing or removing plugs in long lines and transfer lines, consider redundancy in high-risk lines.
M3	Inadequate Design of Mixing Systems	Additional equipment and instrumentation may be required to ensure adequate mixing in WTP vessels using PJMs; additional simulants may be needed, specific mixing tests may be defined (especially if neither prototypic nor full-scale testing is performed before commissioning), operations may be refined to accommodate mixing results, and contingency plans may be developed for internal changes to vessels.	Bubbler issues including solids entrainment; the PJMs potentially not meeting Technology Readiness Level (TRL) 6; undocumented / formal analysis supporting closure of non-Newtonian vessels.	**2010-03:** Document the formal cost-benefit analyses to evaluate potential benefits of additional testing; clearly document the basis for the final vessel assessment closure, and, if high-risk, confirm the technical basis for scaling and ensure access to the vessel if changes are needed; evaluate the safety basis assumptions and methods and test vessel clearing methods.
M5	Must Have Feed Pre-Qualification Capability	The detailed technical basis for waste feed prequalification will need to be completed	Incomplete technical and test specifications (and corresponding uncertainty if LAB is adequate)	**2010-04:** Develop integrated prequalification protocols and "facility;" develop detailed technical basis for waste feed prequalification and use to confirm adequate laboratory capability

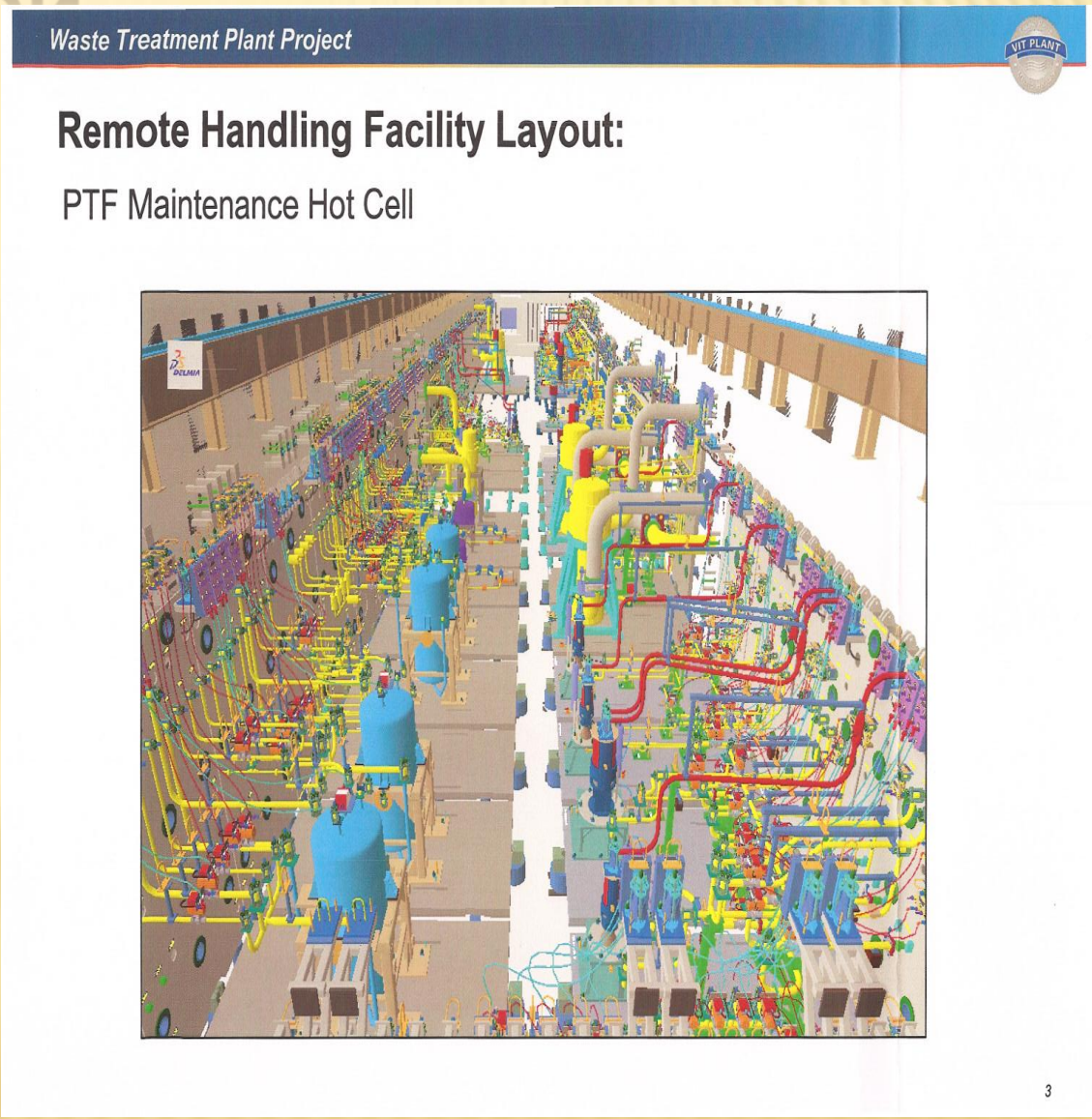
EM-TWS CHARGE 1 RECOMMENDATIONS (CONT'D.)

EFRT Issue	Description	Impact on Commissioning	Additional Concerns	Significant Recommendation
M8	Limited Remotability Demonstration	The development of plans to address remotability issues	Lack of experience with large (> 10") jumpers; how to empty vessels with only a single outlet pump and valve in event of failure	**2010-05:** Develop plans and possible training mock-up to address remotability concerns
M10	Critical Equipment Purchases	**N**o impact.	Limited documentation of bases for decisions concerning "best value" approach.	**2010-06:** Provide additional documentation regarding the criteria used for best value selection; evaluate single supplier for IX resin seed
M14	Instability of Baseline Ion Exchange (IX) Resin (Pretreatment Facility or PT)	There may be impacts on commissioning and operations if the resorcinol formaldehyde (RF) resin is not available due to seed supplier viability.	Testing appears to be limited to support operations.	**2010-07:** Extended testing to confirm ion exchange capacity and resin physical stability/lifetime at this temperature; conduct hazards and operability study (HAZOPS)
M15	Availability, Operability, and Maintainability (PT)	Convert into an ongoing project evaluation that continues through commissioning	Compliance margin based on current Operations Research (OR) model availability may be insufficient.	**2010-08:** Update OR model more frequently (evaluate Reliability, Availability, Maintainability, and Quality Control (QC)
P1	Undemonstrated Decontamination Factor (PT-Evaporators)	Simulant review should take place prior to radioactive functional testing.	Technical specification and performance documentation for the procurement specification have not been confirmed	**2010-09:** Continue to review the impact of foaming; review simulants.
P4	Gelation/Precipitation	Risks will be carried forward to commissioning and operations.	Impacts of changes to prevent gelation have not been assessed throughout affected systems.	**2010-10:** Assess impact of changes to prevent recently observed gelation / precipitation
P5	Inadequate Process Development (PT-IX)	No impact.	Availability of resin seed for WTP Operations has not been confirmed.	**2010-11:** Ensure the availability of RF resin seeds for WTP operations.

EFRT ISSUE M5 LIMITED REMOTABILITY DEMONSTRATION

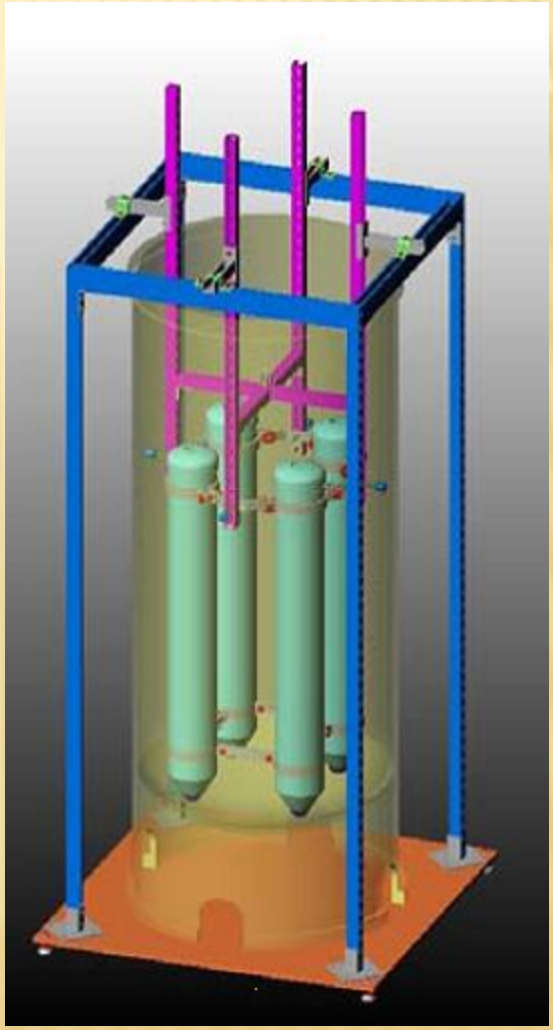
Lack of experience with large (> 10”) jumpers

How to empty vessels with only a single outlet pump and valve in event of failure



EFRT ISSUE M3: PULSE JET MIXERS

- Concern: effectiveness in Non-Newtonian fluids
- EFRT M3 issue closed August 20 without full DOE/contractor consensus
- EM-TWS Recommendations:
  - Document the formal cost-benefit analyses to evaluate potential benefits of additional testing
  - Clearly document the basis for the final vessel assessment closure
  - If high-risk, confirm the technical basis for scaling and ensure access to the vessel if changes are needed
  - Evaluate the safety basis assumptions and methods and test vessel clearing methods



PRINCIPLES OF PULSE JET MIXERS

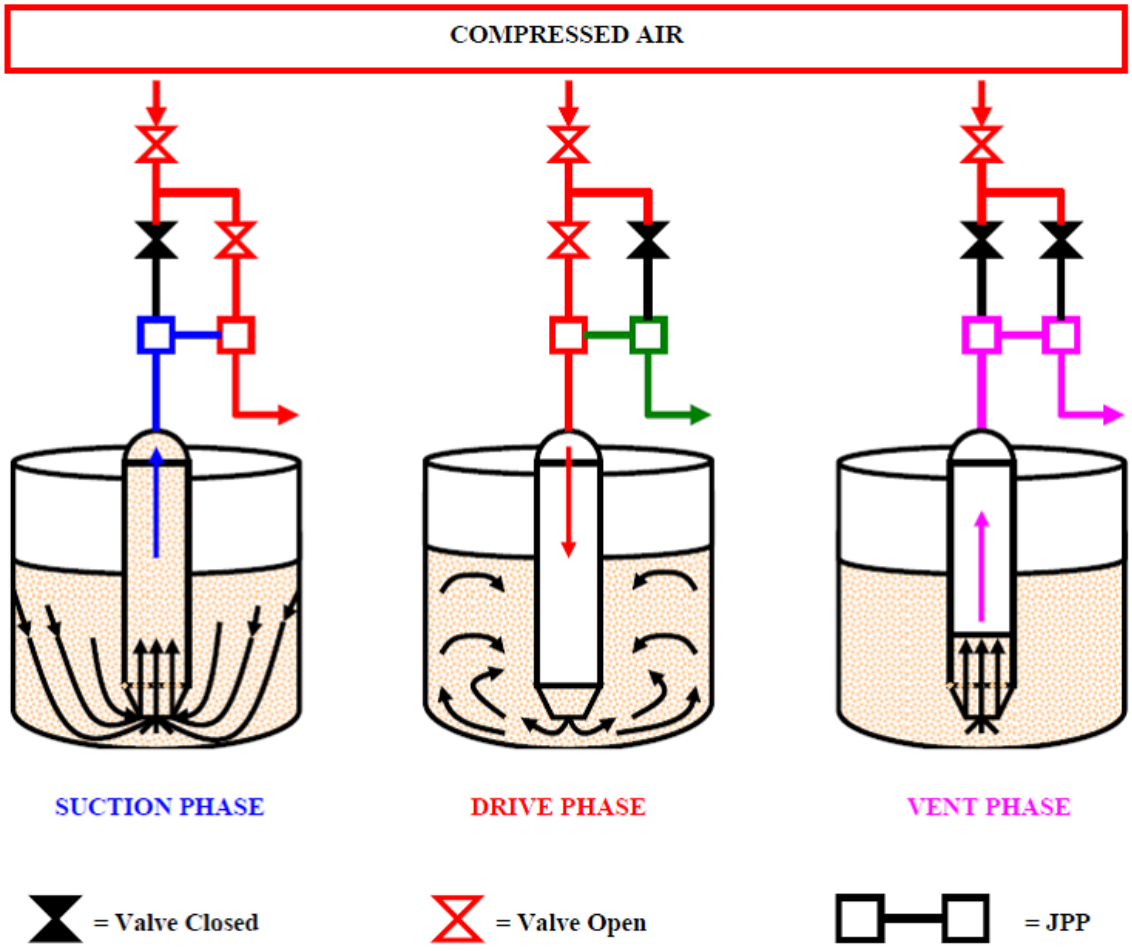
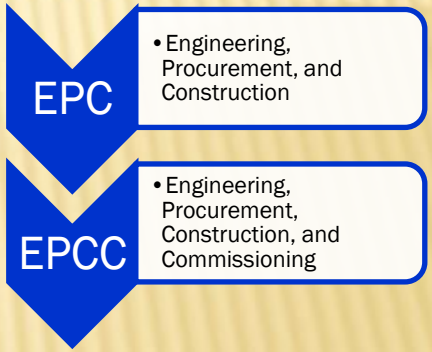


Figure 1.1. Schematic of the Different Phases in a PJM Cycle Control of PJM Operation

SUMMARY – BOTTOM LINE (CHARGE 2)

Charge 2: WTP Technical Design Review



The WTP project has reached the "pivot point" where the principal focus of management attention is shifting from EPC to EPCC. The technical risks associated with EPC have been sufficiently resolved (i.e., the remaining risk is sufficiently low), and the design has advanced to a sufficient level of maturity.

The WTP is being built to contractual functional specifications.

At the present stage of construction, the WTP project is physically constrained, with minimal ability to implement future changes.

On the basis of its review, the EM-TWS has concluded that, independent of the EFRT issues:

- No substantial risk to compliance with contract functional specifications was identified.
- The design appears to be sufficiently mature to proceed with completion of EPC activities.

EM-TWS CHARGE 2 OVERVIEW

- WTP project is advancing toward completion and approaching a "pivot point," i.e. a shift in focus from EPC to final construction, turnover, and commissioning (EPCC).
- Two principal questions raised in Charge 2 concern where the project now stands in relation to that pivot point:
  - Have technical risks associated with EPC been sufficiently resolved?
  - Is the design mature and complete enough so that focus can shift to EPCC with low risk to lifecycle cost and schedule?

EM-TWS CHARGE 2 OBSERVATIONS

- Yes, the WTP project *has* reached the pivot point where the principal focus of management attention may shift from EPC to EPCC. The remaining technical risks are sufficiently low and the design is sufficiently mature.
- The WTP is being built to contractual functional specifications and will continue to be built to them until WTP is completed.
- The systems and work processes in place are adequate to ensure compliance, and sufficient oversight exists to confirm that these systems and process are being properly employed.

EM-TWS CHARGE 2 OBSERVATIONS

- At the present stage of construction, the WTP project is physically constrained, with minimal ability to implement future changes without significant risk to cost and schedule.
- Independent of the EFRT issues:
  - No substantial risk to compliance with contract functional specifications was identified,
  - The design appears to be sufficiently mature to proceed with completion of EPC activities.

EM-TWS CHARGE 2 RECOMMENDATIONS

- **2010-12:** The EPC process should proceed to completion.
- **2010-13:** Given WTP's size and complexity, some future level of nonconformance could evolve; diligence should be maintained in conducting regular and redundant audits to identify and mitigate potential impacts.
- **2010-14:** With the project at its current advanced state of maturation and given the full closure of outstanding EFRT concerns, the focus of attention should shift from EPC to EPCC. This focus requires a coordinated effort by a single owner/operator representative in marrying WTP and Tank Farm activities.
- **2010-15:** DOE, as the project owner/operator, should take near-term action to create a resource base that is concerned with operability and integration of operability concerns and commissioning activities with Tank Farm and WTP.
- **2010-16:** To support this new resource base, DOE should take action to obtain an integrated Tank Farm / WTP plant operator as soon as practicable.

SUMMARY – BOTTOM LINE (CHARGE 3)

Charge 3: WTP Potential Improvements

EM-TWS recommends the following improvements

- Unify the mission with single-point authority and oversight;
- Create a strong Owner/Operator Group;
- Conform with chemical industry best practices;
- Begin development of operator training plans and tools; and
- Evaluate options for improving plant availability

EM-TWS CHARGE 3 OVERVIEW / OBSERVATIONS

- WTP and Tank Farm missions are not well integrated.
- Two different contractors, different planning tools, different assumptions and scenarios for mission completion.
- DOE has been heavily focused on the design and construction of the WTP.
- It appears that the earliest execution of a contract for a WTP operator is at least two years away.
- Successful chemical and nuclear industry projects have generally incorporated a strong owner/operator presence from the very beginning.

EM-TWS CHARGE 3 OVERVIEW / OBSERVATIONS (CONT'D.)

- Plant performance testing and acceptance (contractual) should not take priority over the early demonstration of plant systems based on easier-to-process feed streams.
- Current plans focus on early, full-capacity plant performance and acceptance testing with challenging, difficult-to-process wastes.
- The WTP, when operating, will be a chemical plant that processes radioactive materials. Standard specialized chemical industry practice starts with low-throughput runs using easy-to-process wastes; however, it often takes a year or more for chemical plants to attain smooth operations and reach full capacity.
- Because WTP will be complex to operate, operator training should be extensive.
- Plant availability, i.e. prevention of outages, is critical for achieving the ORP mission.

EM-TWS CHARGE 3 RECOMMENDATIONS

2010-17 *Unify the mission with single-point authority and oversight.*

ORP mission should be run as a single program that incorporates the WTP and Tank Farms. The mission should function under a unified baseline with a consistent set of assumptions and models.

2010-18 *Create a Strong Owner/Operator Group.*

Establish a strong Owner/Operator Group comprising specialized plant operations expertise to

- plan and oversee commissioning and startup, and
- conduct an operator review of final design and construction approvals.

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EM-TWS CHARGE 3 RECOMMENDATIONS (CONT'D)

2010-19 *Alter current contractual startup plans to conform with chemical industry best practices.*

WTP start with easier-to-process waste batches

2010-20 *Begin development of operator training plans and tools.*

Develop training plans and tools with required certifications and operator minimum requirements for service

.

EM-TWS CHARGE 3 RECOMMENDATIONS (CONT'D)

2010-21: Evaluate options for improving availability.

- Establish an integrated commissioning plan that includes simulant definition and development and a feed sequence.
- Review the prequalification sampling capability criteria and plan and review the adequacy of sampling to comply with current and future needs.
- Develop the integrated WTP/Tank Farm cost/benefit models.
- Consider a chemistry-oriented model to aid in operational control and confirmation of instrument and control logic, and develop inputs to that model.

EM-TWS CHARGE 3 RECOMMENDATIONS (CONT'D)

Rec. 2010-18 *Owner/Operator Group: Initial Task Description*

- Evaluate operability uncertainties at the Tank Farm and WTP;
- Evaluate the Tank Farm inventory and its effect on operations;
- Augment the standard DOE nuclear safety basis review by conducting a comprehensive Hazards and Operability Study;
- Define commissioning and operations objectives;
  - Assess the risk of delaying certain design decisions based on forward commissioning activities and specifications (e.g., the project has deferred substantial risk in PJM into commissioning, where modifications may be difficult, costly, and time-consuming)
  - The Owner/Operator Group should complete a commissioning readiness analysis that evaluates the magnitude of the risk that has been deferred, determines the potential impacts of the deferrals, and investigates ways to lessen the impacts

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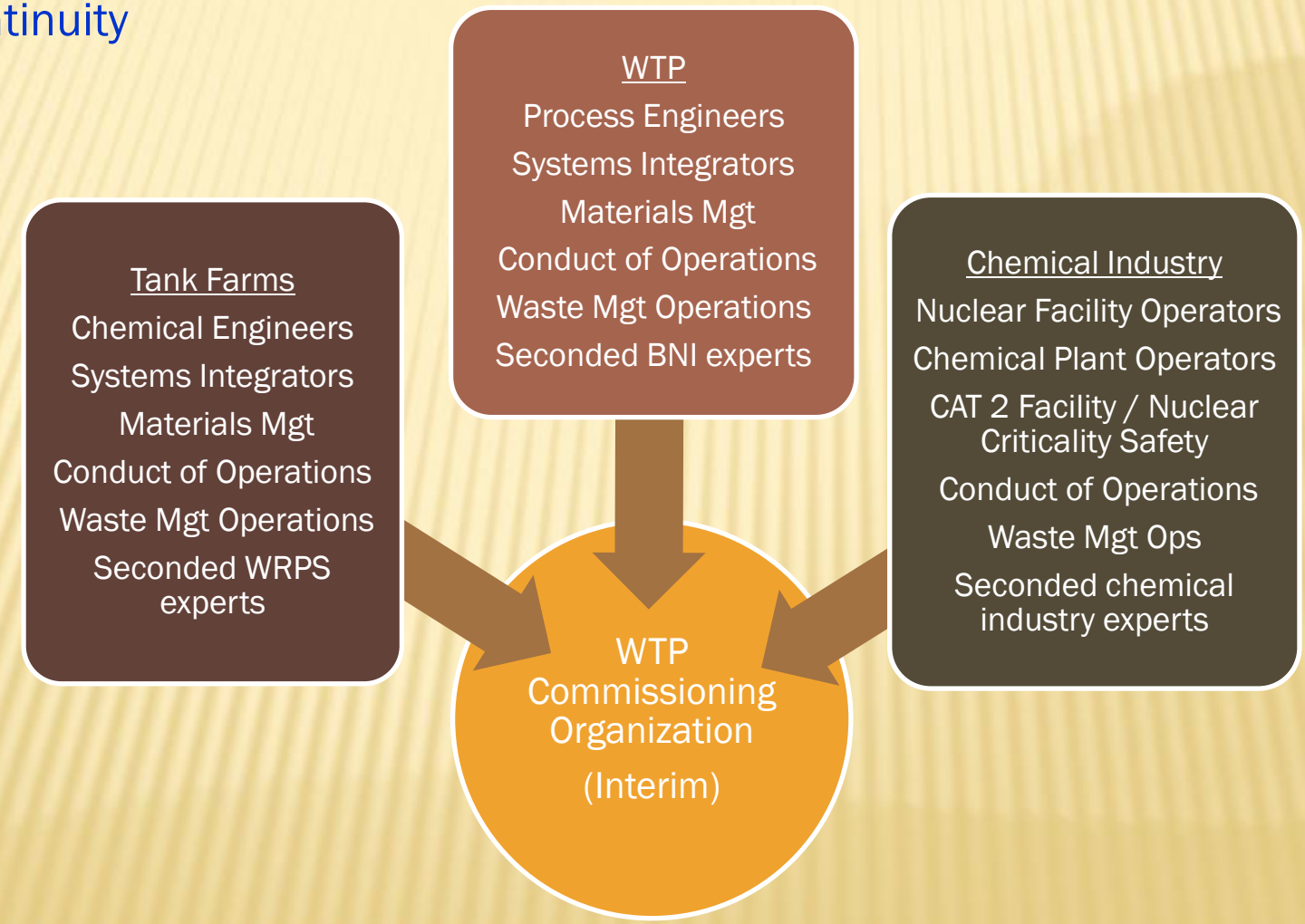
EM-TWS CHARGE 3 RECOMMENDATIONS (CONT'D)

Additional Owner/Operator tasks:

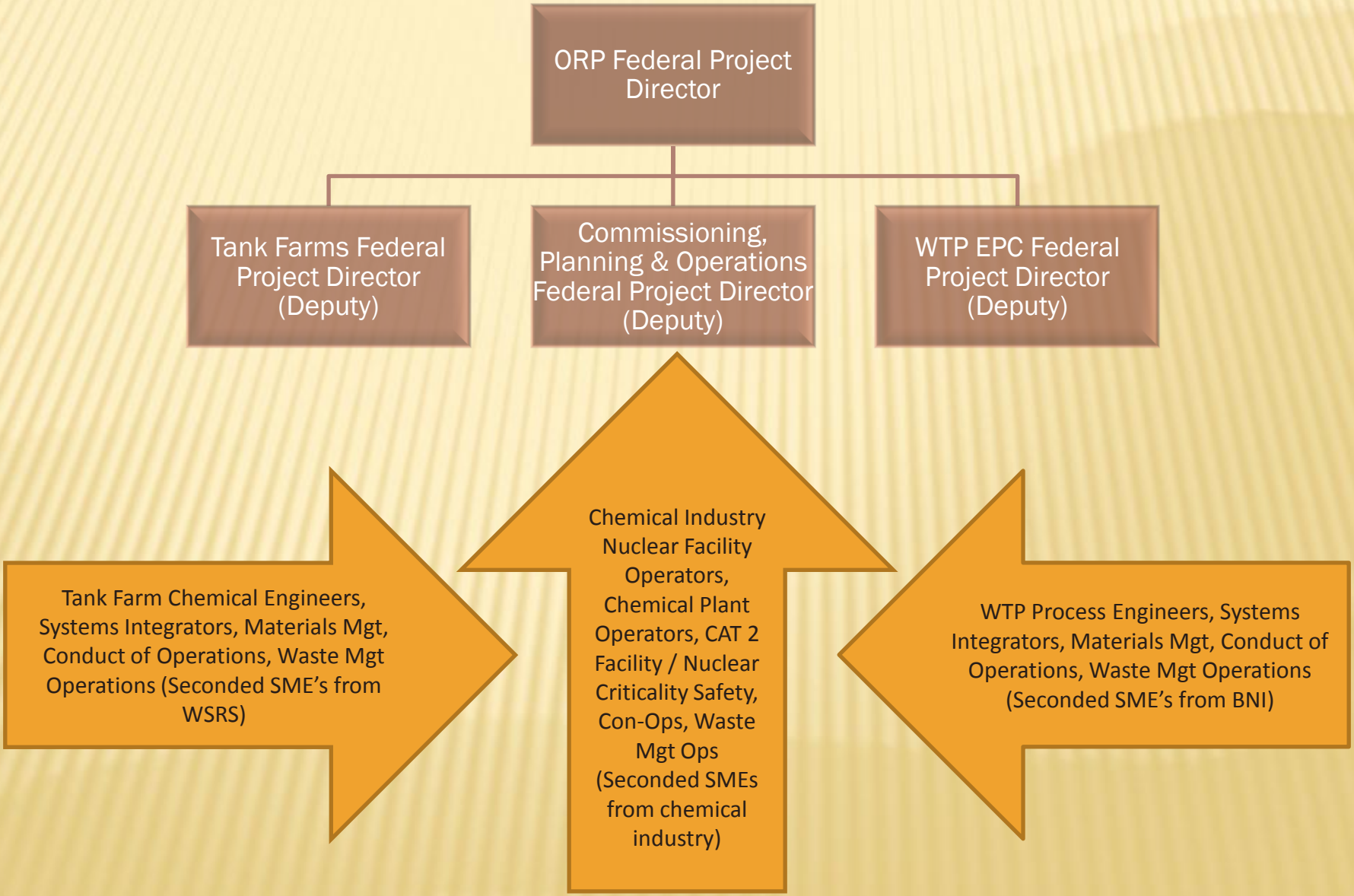
- Assess the risk of delaying certain design decisions based on forward commissioning activities and specifications;
- Establish an integrated commissioning plan that includes simulant definition and development with feed sequence suitable for hot startup;
- Review the prequalification sampling capability criteria and review adequacy of laboratory resources to comply with current and future needs;
- Develop the integrated WTP/Tank Farm cost/benefit models;
- Consider a chemistry-oriented model to aid in operational control and confirmation of instrument and control logic; and
- Confirm regulatory compliance.

COMMISSIONING ORGANIZATION STRUCTURE (INTERIM)

- Draws from best and brightest without sacrificing schedule and transition continuity



INTERIM ORGANIZATIONAL STRUCTURE COMMISSIONING (GO-GO SCIENCE MODEL)



SUMMARY

Charge 1	• No findings prohibit continuation of EPC
Charge 2	• No substantial risk to compliance with contract functional specifications; the design appears to be sufficiently mature to proceed with completion of EPC activities; transition to EPCC model
Charge 3	• Unify the mission with single-point authority and oversight; create a strong Owner/Operator Group; conform with chemical industry best practices; begin development of operator training plans and tools; evaluate options for improving plant availability