Attachment 1 - Phase 1 Screening Tables

Table 1A – Alternatives Rejected (Go-No Go)

Alternative #/Title	Disposition - Comments
15 - Remove Cs/K with Organic Solvent and burn residue at CIF	Reject – Facilities do not exist Reject – Technical Maturity is too low Reject – Residue disposal path/criticality unknown
16 – Burn Tank 48H contents at CIF after Appropriate Dilution	Reject -- Facilities nor interface do not exist
19. – Do Nothing	Reject – Doesn't meet mission
20 – Partner with GrayStar for Cs sources	Reject – Facilities do not exist to strip Cs Reject – Does not address the organic problem
25. – Use an Outside Vendor for Disposal	Reject – Interface Complexity
29 – Remove Supernate and react phenylborate heel in solvent	Reject – This is an intermediate step requiring an unknown solvent and leading to an undetermined outcome

Attachment 1 - Phase 1 Screening Tables

Table 1B – Alternatives That Failed To Meet Screening Criteria

Alternative #/Title	Disposition	Comments
1. Sodium Tetraphenylborate Strike and Filter	Reject –	Produces No Gain Toward Goal
2. Feed KTPB Slurry to DWPF Melter Directly	Reject – Safety Interface	Off Gas Problem Limited Process Rate
4. Feed KTPB Slurry to DWPF Chemical Processing Cell for Decomposition	Reject – Safety Interface	Flammability in the Chem Cell Limited Process Rate
12. Electrochemical Decomposition of TPB	Reject – Maturity	
13. Supercritical Solvent Oxidation	Reject – Safety	
14. DuPont NaTPB Destruction Scheme	Reject – Safety Interface	High Temperature/Pressure A Recycle Process
17. Distribute Tank 48 Contents Among the Other Waste Tanks	Reject – Interface	Compounds the Problem
18. Direct Grout	Reject – Permit ./Interface	Permit Changes Required Interference with Current Feed Plans
21. Add Waste to Tank 48 and Decompose Radiolytically	Reject – Safety Interface	Change in Source Term will effect Authorization Bases. Slow Process
22. Transfer Tank 48 Material to Another Waste Tank and Decompose Radiolytically	Reject – Interface	Takes a Second Tank from Service and The Process is Slow

Alternative #/Title	Disposition	Comments
23. In Tank Bioremediation	Reject – Maturity	
24. Add Tank 48 Material to Another Tank Scheduled to be Decommissioned (Grouted)	Reject – Permit Interface	Curie Content and Organics Would Require New Permit
27. Add Tank 48 Contents to Tank 49	Reject – Interface	Moves the Problem from 48 to 49 with Nothing Gained
28. Send to Containment Facility	Reject – Duplicate of 10	
30. Evaporate to Dryness and Bury or Add to Grout	Reject – Safety Maturity	Handling and Transportation of Dry Material
31. Develop Method to Stabilize Material and Use Tank 48 "As-is"	Reject – Maturity	
32. Pyrolytic Decomposition of Precipitate	Reject – Duplicate of 11	
34. Use of Solvent to Extract KTPB, Park Solvent in Unused Waste Tank	Reject – Safety Interface	Flammability Organics Sill Exist
35. MST/TPB Strike in the Flow Sheet for the HLW System	Reject – Interface	Requires MST/TPB and Salt Cell – Neither Existing or Planned

Attachment 1 - Phase 1 Screening Tables

Table 1C – Alternatives That Are Accepted In Part

Alternative #/Title	Disposition	Comments
26. Metathesize with Cold Cesium	Consider in Part – Does not Satisfy Mission Statement	Precursor to Another Solution
35. Actinide Removal Process (ARP) Using Permanganate	Consider in Part – Hybrid – Does not Utilize Existing or Planned Facilities	
36. Tank in Tank	Consider in Part – Hybrid – Does not Utilize Existing or Planned Facilities	
37. Microwave Destruction of Organics	Consider in Part – Hybrid – Maturity may not Exist for Tank 48 Material	

Attachment 1 - Phase 1 Screening Tables

Table 1D – Alternatives That Are Accepted

Alternative #/Title	Disposition	Comments
3. Feed KTPB Slurry to DWPF Salt/Cell for Decomposition	Accept	
5. Chemically Decompose TPB Directly in Tank Using a Catalyst	Accept	
6. Chemically Decompose Directly in a New or Existing Facility Outside Tank 48 Using a Catalyst	Accept	
7. Chemically decompose Directly in Tank by Lowering pH (Acid Addition)	Accept	
8. Photolytically Decompose Tetraphenylborate Compounds Using TiO_2	Accept	
9. Decompose by Addition of Water Soluble Mild Oxidant	Accept	
10. TPB Decomposition Using Permanganate1	Accept – New Tank/Facility	
11. Thermal Decomposition in DWPF, Send Residue to Melter	Accept	
33. Tank 49 as a Reaction Vessel	Accept	
38. Volume – Reduce by Filtration, Sending Filtrate to Tank 50, Decompose Residual In-Tank	Accept	
39. Steam Reforming/Fluidized Bed	Accept	

ATTACHMENT 2 – ALTERNATIVE INFORMATION SHEETS

The following pages are the summaries from each of the alternatives that were considered by the team. For each alternative, a summary was prepared that included the following information:

- Alternative Number
- Sponsor
- Date
- Title
- Description:
- Advantages
- Disadvantages
- Safety Issues
- Permitting Issues
- Interface Issues
- Technical Issues
- Technical Maturity

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative # 1	**Sponsor:** R. C. Fowler	**Date:** 1/14/02

Title	Sodium Tetraphenylborate Strike and Filter
Description	Make a NaTPB strike in Tank 48 to reduce soluble cesium-137 content. Filter supernate until the tank contains approximately 10 % solids. Dispose of the filtrate in Tank 50 (and subsequently Saltstone). Use remaining space in Tank 48 for addition of new waste.
Advantages	Relatively simple and involves no new technology development
Disadvantages	Limited gain in space. Tank would still contain organic material making it unsuitable for transfer to rest of Tank Farm.
Safety Issues	Addition of NaTPB and fresh waste to Tank 48 would require modification and approval of the current Authorization Basis
Permitting Issues	None
Interface Issues	None
Technical Issues	None
Technical Maturity	High. Proposal uses existing ITP Technology

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	2	**Sponsor**	Dan Lambert	**Date**	1-14-2002
Title	Feed KTPB slurry to DWPF melter directly				
Description	A small transfer of the Tank 48 Contents would be metered into the DWPF SME at the completion of the SME cycle. The SME slurry is transferred to the DWPF MFT and fed to the DWPF melter.				
Advantages	1. This is a simple disposal method with no processing required in DWPF. No washing of the KTPB slurry is necessary 2. If the TPB slurry is dilute (<10 wt % insoluble solids), the slurry can be concentrated further and the filtrate fed to Saltstone. This will minimize the volume to be processed by DWPF.				
Disadvantages	1. The tetraphenylborate may decompose to benzene in the SME or MFT. These tanks and their purges were not designed to handle that a large quantity of benzene. DWPF PHA was limited to 53 ppm PBA (equivalent to 30 ppm benzene) to prevent a flammable mixture from forming in the feed tanks or during processing. 2. The tetraphenylborate may decompose to tar-like organics that may lead to processing problems (organic buildup hindering heat transfer and plugging piping) in DWPF. 3. The tetraphenylborate and its decomposition products will be oxidized in the melter cold cap. If it is not completely oxidized to CO_2, it may lead to a flammable mixture (CO) in the melter offgas system. 4. The tetraphenylborate may reduce the metals present in the melter feed particularly the noble metals. This could shorten melter life. 5. As with any process done outside of Tank 48, there will likely be a significant heel left in Tank 48. 6. A new DWPF flowsheet would be necessary to add unwashed KTPB slurry to DWPF. The unwashed slurry would have significant sodium that may impact the choice of frit that is used in DWPF.				
Safety Issues	Flammability of benzene in the CPC offgas system and flammability of CO in the melter offgas.				
Permitting Issues	None				
Interface Issues	1. Any direct feeding of KTPB slurry to the DWPF melter would likely exceed the DWPF Total Organic Carbon limit for the melter feed. 2. DWPF piping would need to be modified to allow transport the KTPB slurry into the SME or MFT.				
Technical Issues	1. Transportation of KTPB slurries can be a challenge. Foaming and the high yield stress of KTPB slurries make transportation difficult. 2. Decomposition of the KTPB in the DWPF SME will lead to steam stripping of organics into the offgas system. Presence of these tar-like organics has lead to operational problems in pilot operations.				
Technical Maturity	Medium – This was considered as an alternative in the development of the DWPF process.				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	3	**Sponsor**	Dan Lambert	**Date**	1-14-2002
Title	Feed KTPB slurry to DWPF salt cell for decomposition				
Description	The Tank 48 Contents would be washed in the late wash facility, processed in the DWPF Salt Cell to destroy the TPB and combined with the sludge in the DWPF SRAT. This is the current DWPF process.				
Advantages	The DWPF Salt Cell was designed to process the KTPB slurry. If the TPB slurry is dilute (<10 wt % insoluble solids), the slurry can be concentrated further and the filtrate fed to Saltstone. This will minimize the volume to be processed by DWPF.				
Disadvantages	As with any process done outside of Tank 48, there will likely be a significant heel left in Tank 48. It is likely that significantly more than 250,000 gallons of waste will be generated. The startup of the Late Wash Facility and the restart of the SPC will be complicated by the presence of radioactivity in DWPF. The SPC canyon space could not be used for other processing that is being considered such as alpha removal. Additional processing in DWPF is likely to extend processing time, as the analytical laboratory may become the DWPF bottleneck. The DWPF analytical lab will have to reestablish analytical support for the salt cell processing.				
Safety Issues	None.				
Permitting Issues	None.				
Interface Issues	The KTPB slurry would have to be washed prior to processing. This would involve restarting the DWPF Late Wash Facility and the DWPF Salt Cell. A method would need to be developed to dispose of benzene with the shutdown of the Consolidated Incinerator Facility.				
Technical Issues	Transportation of KTPB slurries can be a challenge. Foaming and the high yield stress of KTPB slurries make transportation difficult.				
Technical Maturity	High				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	4	**Sponsor**	Dan Lambert	**Date**	1-14-2002
Title	Feed KTPB slurry to DWPF salt cell for decomposition				
Description	The Tank 48 Contents would be washed in the late wash facility processed in the DWPF Salt Cell to destroy the TPB and combined with the sludge in the DWPF SRAT. This is the current DWPF process.				
Advantages	1. The DWPF Salt Cell was designed to process the KTPB slurry. 2. If the TPB slurry is dilute (<10 wt % insoluble solids), the slurry can be concentrated further and the filtrate fed to Saltstone. This will minimize the volume to be processed by DWPF.				
Disadvantages	1. As with any process done outside of Tank 48, there will likely be a significant heel left in Tank 48. It is likely that significantly more than 250,000 gallons of waste will be generated. 2. The startup of the Late Wash Facility and the restart of the SPC will be complicated by the presence of radioactivity in DWPF. 3. The SPC canyon space could not be used for other processing that is being considered such as alpha removal. 4. Additional processing in DWPF is likely to extend processing time, as the analytical laboratory may become the DWPF bottleneck. The DWPF analytical lab will have to reestablish analytical support for the salt cell processing.				
Safety Issues	None.				
Permitting Issues	None.				
Interface Issues	1. The KTPB slurry would have to be washed prior to processing. This would involve restarting the DWPF Late Wash Facility and the DWPF Salt Cell. 2. A method would need to be developed to dispose of benzene with the shutdown of the Consolidated Incinerator Facility.				
Technical Issues	1. Transportation of KTPB slurries can be a challenge. Foaming and the high yield stress of KTPB slurries make transportation difficult.				
Technical Maturity	High				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	5	**Sponsor**	Dan Lambert	**Date**	1-15-2002
Title	Chemically decompose TPB directly in tank using a catalyst				
Description	Adding a catalyst would increase the decomposition rate of the TPB present in Tank 48. The benzene produced in the tank would be removed through evaporation.				
Advantages	1. This is disposal method would utilize existing processing facilities. 2. This is similar to the method used for Tank 49. 3. If the TPB slurry is dilute (<10 wt % insoluble solids), the slurry can be concentrated further and the filtrate fed to Saltstone. This will minimize the quantity to be processed. 4. No washing of the KTPB slurry is necessary. 5. Since the processing will be completed in the waste tank, there will be no unprocessed material in the tank.				
Disadvantages	1. Would need to resolve DNFSB 96-1 issues prior to commencing processing. 2. It will be difficult to control the rate of TPB decomposition and the byproducts of the decomposition in a waste tank. The decomposition products of the decomposition are likely to form tar-like organics that may cause future processing problems. 3. The decomposition reaction rate will be controlled by the concentration of catalyst, waste temperature and liquid pH. To prevent high benzene generation, it is likely that reaction rate will initially be high and will decrease over time. It is likely that higher temperature and lower pH will be required to maximize the decomposition rate. 4. The Tank 48 waste after decomposition will likely require additional treatment to meet WAC requirements due to the organic byproducts of the TPB decomposition. 5. The benzene disposal path is through evaporation. If all the potential benzene in the TPB decomposes to benzene and evaporates, approximately 100,000 kg of benzene will be released. Permit modifications may be required to handle benzene emissions				
Safety Issues	Flammability of benzene in Tank 48. Tank 48 was not designed to be a reaction vessel. Benzene is heavier than air and will accumulate near the liquid surface. A loss of ventilation would lead to flammability concerns, especially if temperature cycling leads to the addition of oxygen to the waste tank.				
Permitting Issues	The benzene limit might need to be readdressed, as the annual benzene limit will be exceeded if all the TPB decomposes to benzene and evaporates.				
Interface Issues	Additional processing may be necessary to handle the Tank 48 waste after decomposition is complete. Additional processing (organic removal) may be necessary.				
Technical Issues	1. How to control the decomposition rate. 2. How to minimize the production of unwanted byproducts. 3. Decomposition of KTPB is much more difficult than NaTPB. 4. How to accomplish decomposition without damaging waste tank (corrosion).				
Technical Maturity	Medium				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	6	**Sponsor**	Dan Lambert	**Date**	1-15-2002
Title	Chemically decompose directly in a new or existing facility outside Tank 48 using a catalyst				
Description	A new process facility would be built to chemically decompose the TPB slurry using a catalyst. This new facility could take that place of the late wash facility and the DWPF salt cell or be used to decompose the TPB solution without washing.				
Advantages	1. A well-designed facility can be constructed to process the KTPB slurry. This is known technology that would require minimal development. 2. Benzene can be purified (radioactivity removed) to the point that it can be incinerated offsite. 3. The TPB will be decomposed to benzene so the final slurry should be acceptable for feeding to DWPF or returning to a waste tank.				
Disadvantages	1. There would be a significant investment in the construction of a new facility. 2. As with any process done outside of Tank 48, there will likely be a significant heel left in Tank 48.				
Safety Issues	None.				
Permitting Issues	A new facility would require new permits.				
Interface Issues	1. A method would need to be developed to dispose of benzene with the shutdown of the Consolidated Incinerator Facility.				
Technical Issues	1. Transportation of KTPB slurries can be a challenge. Foaming and the high yield stress of KTPB slurries make transportation difficult.				
Technical Maturity	High				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	7	**Sponsor**	Dan Lambert	**Date**	1-15-2002
Title	Chemically decompose directly in tank by lowering pH (acid addition)				
Description	Lowering the pH would increase the decomposition rate of the TPB present in Tank 48. It is likely that higher temperature and a catalyst would be required to maximize the decomposition rate. The benzene produced in the tank would be removed through evaporation.				
Advantages	1. This is disposal method would utilize existing processing facilities. 2. This is similar to the method used for Tank 49. 3. If the TPB slurry is dilute (<10 wt % insoluble solids), the slurry can be concentrated further and the filtrate fed to Saltstone. This will minimize the quantity to be processed. 4. No washing of the KTPB slurry is necessary. 5. Since the processing will be completed in the waste tank, there will be no unprocessed material in the tank.				
Disadvantages	1. Would need to resolve DNFSB 96-1 issues prior to commencing processing. 2. It will be difficult to control the rate of TPB decomposition and the byproducts of the decomposition in a waste tank. The decomposition products of the decomposition are likely to form tar-like organics that may cause future processing problems. 3. The decomposition reaction rate will be controlled by the concentration of catalyst already present in Tank 48, waste temperature and liquid pH. To prevent high benzene generation, it is likely that reaction rate will initially be high and will decrease over time. 4. The Tank 48 waste, after decomposition will likely require additional treatment to meet Waste acceptance requirements due to the organic byproducts of the TPB decomposition. 5. The benzene disposal path is through evaporation. If all the potential benzene in the TPB decomposes to benzene and evaporates, approximately 100,000 kg of benzene will be released. The likely benzene emissions are significantly lower. Permit modifications may be required to handle benzene emissions.				
Safety Issues	1. Flammability of benzene in Tank 48. Tank 48 was not designed to be a reaction vessel. Benzene is heavier than air and will accumulate near the liquid surface. A loss of ventilation would lead to flammability concerns, especially if temperature cycling leads to the addition of oxygen to the waste tank. 2. Corrosion will be increased by the addition of acid to lower the pH. A low pH (bulk solution or locally) is expected to increase the Tank corrosion rate.				
Permitting Issues	The benzene limit might need to be readdressed, as the annual benzene limit will be exceeded if all the TPB decomposes to benzene and evaporates.				
Interface Issues	1. Additional processing may be necessary to handle the Tank 48 waste after decomposition is complete. Organic removal may be necessary.				
Technical Issues	1. How to accomplish decomposition without damaging waste tank (corrosion). 2. How to control the decomposition rate. 3. How to minimize the production of unwanted byproducts. - Decomposition of KTPB is much more difficult than NaTPB.				
Technical Maturity	Medium				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	8	**Sponsor**	R. C. Fowler	**Date**	1-14-2002
Title	Photolytically Decompose Tetraphenylborate Compounds Using TiO_2				
Description	An ultraviolet (UV) source and a titanium dioxide bed would be used to decompose the organic material in Tank 48. The slurry would be drawn from the tank using the existing transfer pump and passed through the bed allowing the UV light to breakdown the organic material while the TiO_2 would serve as a catalyst. The operation would require a shielded facility such as the filter cells in building 241-96H (the old ITP filter building). Once the organics were destroyed, the tank would be capable of accepting waste from the Tank Farm and vice versa.				
Advantages	Uses existing facilities and does not introduce new chemical compound to the system				
Disadvantages	Research required for determining reaction rates and effectiveness of operation. Refurbishing of the ITP Filter Building for new use. A technology not used before on HLW				
Safety Issues	The new system will have to be addressed by the Authorization Basis. Shielding workers from UV source				
Permitting Issues	None				
Interface Issues	None				
Technical Issues	New technology for HLW. Effectiveness and speed of decomposition not known.				
Technical Maturity	Low. Development still needed				

Alternative #	9	**Sponsor**	Peters	**Date**	1-21-2002
Title	Decompose by addition of water soluble mild oxidant				
Description	We propose to locate a water soluble, stable, mild oxidant, such as a metal peroxide/superoxide. Such a compound could react in a stoichiometric fashion to destroy the TPB (and possibly the other phenylborates). Ideally, the byproducts of such a reaction would be inconsequential (phenol or CO2, for example).				
Advantages	The reaction would be controlled by the gradual addition of the oxidant (a non-catalytic reaction). Byproducts should be of no issue.				
Disadvantages	The target compound has to be located and tested. It may not exist, but a literature search can determine that.				
Safety Issues	A new compound would be added to the tank, and the reaction capability of this material must be well understood.				
Permitting Issues	No new waste streams should be generated.				
Interface Issues	This should require no new facilities or structures.				
Technical Issues	The candidate compound/s/ must be located. The reaction rates and byproducts must be determined.				
Technical Maturity	None at the scale of the waste tank.				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	10	**Sponsor**	Peters	**Date**	1-21-2002
Title	TPB decomposition using permanganate				
Description	Using a procedure similar in nature to what is used in the SRTC Containment building, it may be possible to completely break the phenylborates down into benzene and boric acid. This process involves adding sodium permanganate, oxalic acid and phosphoric acid. The ratio currently used at SRTC involved about 2 L of added chemicals to 1 L of TPB waste, although this varies somewhat.				
Advantages	The process, in smaller scale, is already being used. The chemistry is fairly understood. The process is also not catalytic and reaction runaway can be avoided.				
Disadvantages	Process may not scale up well and requires close monitoring during the addition of the chemicals.				
Safety Issues	Does this reaction need a corrosion study to insure to corrosion problems do not exist, if we do this in a steel reactor?				
Permitting Issues	: Potential issues in adding new materials to the tank (oxalic, phosphoric acids and permanganate).				
Interface Issues	A small reactor would be constructed.				
Technical Issues	May not scale up well.				
Technical Maturity	Fairly well understood and utilized.				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	11	**Sponsor**	Dan Lambert	**Date**	1-17-2002
Title	Thermal decomposition in DWPF, send residue to melter				
Description	High temperature (~350°C) process for destroying TPB. TPB would further decompose to form a salt/carbon/boron residue that will be fed to the DWPF melter. The decomposition product would be benzene in an inert environment and CO_2 in an air environment.				
Advantages	1. High temperature (but not high pressure) leads to high reaction rate for decomposition of TPB. 2. It is likely that no addition chemicals (such as formic acid and cupric nitrate) are needed to complete the reaction. .				
Disadvantages	1. As with any process done outside of Tank 48, there will likely be a significant heel left in Tank 48. 2. A new facility would be required. 3. Significant research would be necessary to develop workable process. 4. It may be difficult to transfer the residue to the DWPF melter. 5. The addition of the residue to the melter may lead to a glass that is more reducing. 6. As with any process done outside of Tank 48, there will likely be a significant heel left in Tank 48.				
Safety Issues	1. How to safely thermally decompose the TPB. 2. High temperature process.				
Permitting Issues	1. New facility will need benzene permit for processing. 2. Need way to get rid of produced benzene.				
Interface Issues	1. . Will need to transfer TPB slurry to new facility. 2. Will need to transfer the residue to the DWPF melter.				
Technical Issues	1. What are the conditions for rapid but safe TPB decomposition? - How to safely operate high temp radioactive process safely?				
Technical Maturity	Medium				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	12	**Sponsor**	Peters	**Date**	1-21-2002
Title	Electrochemical decomposition of TPB				
Description	TPB is a mild reducing agent and so should be susceptible to attack by oxidizing agents. In this case, an oxidizing current in the tank may decompose the TPB. (**talk to David**)				
Advantages	No new chemicals added to the tank. The process would be controlled by delivery of current and thus could be stopped quickly.				
Disadvantages	Does it work? New equipment needs to be designed to add to the tank (electrodes).				
Safety Issues					
Permitting Issues					
Interface Issues					
Technical Issues	Totally untried, but sound in theory.				
Technical Maturity	None from our perspective, but the theory is sound.				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	13	**Sponsor**	Peters	**Date**	1-21-2002
Title	Supercritical solvent oxidation				
Description	Supercritical solvents (water, CO_2, etc) can dissolve otherwise intractable solids. Furthermore, supercritical water is known to be able to completely destroy organic compounds. Experiments performed at Sandia demonstrated effective destruction of the organic components of a simulated DOE mixed waste (radioactive plus organic waste).				
Advantages	Offers complete destruction of phenylborates with the use of no new solvents or chemicals. A very "green" technology.				
Disadvantages	Would require building of new equipment, including a high-pressure (220 psig+ in the case of supercritical water) reactor.				
Safety Issues	Would require a high-pressure reactor and building. This is most likely a large safety issue.				
Permitting Issues	None, other than high-pressure equipment.				
Interface Issues	Would require some sort of vessel/building to be constructed.				
Technical Issues	Would this scale up well?				
Technical Maturity	Supercritical solvent work is being extensively pursued in the industry as well as some government labs (LANL).				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	14	**Sponsor**	Dan Lambert	**Date**	1-16-2002
Title	DuPont NaTPB destruction scheme (same as supercritical water oxidation?) to decomposed TPB outside Tank 48.				
Description	DuPont developed a high temperature hydrolysis process for destroying triphenylborane (3PB) using a high temperature (200°C), high-pressure process (250 psig) to hydrolyze 3PB to benzene. This process should work as well for TPB as 3PB. The process is carried out at a near neutral pH (~7)				
Advantages	1. High temperature leads to high reaction rate for decomposition of TPB. 2. It is likely that no addition chemicals (such as formic acid and cupric nitrate) are needed to complete the reaction.				
Disadvantages	1. A new facility would be required. 2. Significant research would be necessary to develop workable process. 3. As with any process done outside of Tank 48, there will likely be a significant heel left in Tank 48.				
Safety Issues	1. Flammability of benzene in new facility. 2. High temperature and high pressure process. This is the original TPB destruction process before the copper catalyst allowed the reaction to occur at 100°C.				
Permitting Issues	1. New facility will need benzene permit for processing. 2. Need way to get rid of produced benzene.				
Interface Issues	1. Will need to transfer resulting product (B, Cs, K) to waste tank. 2. Will need to transfer TPB slurry to new facility.				
Technical Issues	1. What are the conditions for rapid but safe TPB decomposition? 2. How to safely operate high temp, high-pressure radioactive process?				
Technical Maturity	Medium				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	15	**Sponsor**	R. C. Fowler	**Date**	1-14-2002
Title	Remove Cs/K with Organic Solvent and burn residue at CIF				
Description	Develop an organic solvent to strip the cesium from the Tank 48 material. Some potassium would probably be absorbed in the process. This would deplete the tetraphenylborate precipitate of most of its radioactive content allowing it to be burned at CIF. The solvent containing the cesium would have to be stored or processed further at a later time				
Advantages	Concentrates radioactive cesium segment into a smaller volume, phenylborates are destroyed.				
Disadvantages	The need for an organic radioactive storage still remains, however at a smaller volume. Need to find another storage vessel in order to reclaim Tank 48 for Tank Farm use.				
Safety Issues	New process. Need to have an Authorization Basis update before implementation. Worker training needs to handle new solvent and new process.				
Permitting Issues	Organic solvent may require modification to environmental permits				
Interface Issues	Impact of solvent will have to be evaluated for impact to CIF, DWPF and Tank Farm				
Technical Issues	Development of suitable solvent and determination if process can be implemented in-tank and if it must be performed out of tank.				
Technical Maturity	Low, no work done in this area to date.				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	16	**Sponsor**	R. C. Fowler	**Date**	1-14-2002
Title	Burn Tank 48 Contents at CIF After Appropriate Dilution				
Description	Dilute the contents of Tank 48 to meet the waste acceptance criteria of CIF. Transport the material to CIF and incinerate it.				
Advantages	Existing technology.				
Disadvantages	No direct path to CIF. Need to find pipeline or some way to "truck it"to the CIF. Radiological content of the tank is high, which might require a very large dilution. CIF is currently shutdown and in standby.				
Safety Issues	Effect of the radiological release need to be evaluated for co-located workers and off-site personnel.				
Permitting Issues	Evaluation of the proposed activity against existing permits must be done.				
Interface Issues	Neither facility is designed for this type of waste movement.				
Technical Issues	Shipment of the material. Meeting the CIF waste acceptance criteria				
Technical Maturity					

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	17	**Sponsor**	R. C. Fowler	**Date**	1-14-2002
Title	Distribute Tank 48 Contents Among the Other Waste Tanks				
Description	Using the current waste transfer system, distribute small amounts of Tank 48 material to all available tanks throughout the Tank Farm. By placing small amounts of the precipitate in many tanks, the hope is to maintain any individual tank below the threshold of declaring it an organic tank, thus freeing Tank 48 for new waste transfers.				
Advantages	No technology development. Relatively inexpensive.				
Disadvantages	An evaluation must be performed for each tank receiving the material to ensure it meets the organic limit. There may be to great a quantity of organics to be distributed in the Tank Farm. Administrative and Operational problems trying to make many very small transfers				
Safety Issues	Need to ensure the LFL limits of individual tanks are not challenged by the addition of organics.				
Permitting Issues	None				
Interface Issues	Need evaluation of impact of adding this material to remaining tanks on the eventual waste processing facilities (DWPF, Saltstone).				
Technical Issues	None				
Technical Maturity	High, waste transfers are common in the Tank Farm				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	18	**Sponsor**	R. C. Fowler	**Date**	1-14-2002
Title	Direct Grout				
Description	Send the material in Tank 48 to Saltstone to be disposed of as grout. Movement of the precipitate to Tank 50 may be required before transferring it to Saltstone. Material can be diluted with existing Tank 50 material and				
Advantages	Existing technology. Relatively quick and inexpensive.				
Disadvantages	Phenylborate content may be too high for Saltstone. Radioactive content may be too high for Saltstone. Permitting issues				
Safety Issues	Addition of Tank 48 to Tank 50 could cause a reaction of waste with the precipitate resulting in unwanted benzene emissions. Tank 50 has no inerting capability.				
Permitting Issues	Material may not meet Saltstone Waste Acceptance Criteria				
Interface Issues	Material may not meet Saltstone Waste Acceptance Criteria.				
Technical Issues	None				
Technical Maturity	High. The transfer and processing of ITP Batch1 and ETF bottoms has been done in Saltstone for years.				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	19	**Sponsor**	R. C. Fowler	**Date**	1-14-2002
Title	Do Nothing				
Description	Keep conditions at the status quo. No transfers into or out of Tank 48				
Advantages	Cheapest alternative				
Disadvantages	No gain in available space to the Tank Farm				
Safety Issues	None				
Permitting Issues	None				
Interface Issues	None				
Technical Issues	None				
Technical Maturity	High, currently being done.				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	20	**Sponsor**	Peters	**Date**	1-21-2002
Title	Partner with GrayStar for Cs-137 sources				
Description	The GrayStar company (www.graystarinc.com) has formulated a plan to privatize all the Cs-137 in the government inventory and use it for food irradiation. It is possible to collect the Cs-137 in Tank 48H (among) others and sell it to GrayStar. This is not a solution in and of itself, but part of a disposal pathway.				
Advantages	The cesium-137 goes to someone else.				
Disadvantages	This would require chemical stripping and separation of the cesium. A new reactor and/or facility would be required.				
Safety Issues					
Permitting Issues	GrayStar would likely have to do all the paperwork to accept the Cs-137.				
Interface Issues	Would require some sort of vessel/building to be constructed.				
Technical Issues	There is 250,000 gal we would have to process.				
Technical Maturity	: The cesium stripping is not a new technology. It is well understood, but the difficulty is in processing such a large amount of material.				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	21	**Sponsor**	R. C. Fowler	**Date**	1-14-2002
Title	Add Waste to Tank 48 and Decompose Radiolytically				
Description	Add radioactive waste to Tank 48 to promote the radiolytic decomposition of the precipitate. Use the existing nitrogen purge ventilation system to exhaust the benzene vapor produced				
Advantages	No new technology. Uses existing systems. Relatively inexpensive				
Disadvantages	Possibly very slow, which would consume a substantial quantity of nitrogen. Would need development of reaction rate constants to predict benzene generation. If benzene generation too high, could pose LFL problem				
Safety Issues	LFL issues related to unknown benzene generation rate				
Permitting Issues	May need air permit revision for this quantity of benzene release.				
Interface Issues	Pathway to transfer waste into Tank 48 would need to be evaluated. Might require some diversion box work.				
Technical Issues	Phenylborate decomposition rates with the waste to be transferred need development				
Technical Maturity	Low, radiolytic decomposition rates are unknown				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	22	**Sponsor**	R. C. Fowler	**Date**	1-14-2002
Title	Transfer Tank 48 Material to Another Waste Tank and Decompose Radiolytically				
Description	Transfer the precipitate material from Tank 48 to another radioactive waste tank to promote the radiolytic decomposition of the phenylborate compounds. The transfer would use the existing pumps and piping. The existing ventilation system to exhaust the benzene vapor produced.				
Advantages	No new technology. Uses existing systems. Relatively inexpensive				
Disadvantages	Possibly very slow. Would need development of reaction rate constants to predict benzene generation. If benzene generation too high, could pose LFL problem. Would not have nitrogen purge system as a "defense in depth".				
Safety Issues	LFL issues related to unknown benzene generation rate				
Permitting Issues	Would require air permit revision for this quantity of benzene release.				
Interface Issues	Pathway to transfer waste into Tank 48 would need to be evaluated. Might require some diversion box work.				
Technical Issues	Phenylborate decomposition rates with the waste to be transferred need development				
Technical Maturity	Low, radiolytic decomposition rates are unknown				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	23	**Sponsor**	Peters	**Date**	1-21-2002
Title	In tank bioremediation				
Description	A wide variety of organic compounds can be degraded through the use of different bacterial strains. Although there is no record of any bacteria strain specifically attacking phenylborates, it may be possible for suitable bacteria to act in this way.				
Advantages	Benzene, as an end product, is usually avoided in bioremediation.				
Disadvantages	Organics are not totally degraded (to CO2). Left over organics may be problematic. Bacteria unlikely to survive in high caustic, so a reactor may be required.				
Safety Issues	Various organics would be introduced in the tank as byproducts of the bioremediation.				
Permitting Issues	None known				
Interface Issues	A reactor is likely to be needed.				
Technical Issues	A suitable species must be located and tested. The byproducts of the degradation must be known.				
Technical Maturity	Bioremediation, as a general process is well known and understood. With respect to phenylborates, this is an unknown technology.				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	24	**Sponsor**	R. C. Fowler	**Date**	1-14-2002
Title	Add Tank 48 Material to Another Tank Scheduled to be Decommissioned (Grouted)				
Description	Transfer the material in Tank 48 to one of the waste tanks scheduled to be decommissioned. The decommissioned tank is slated to be filled with grout after its contents have been removed. The Tank 48 precipitate material would be mixed into the grout matrix as a final disposal method.				
Advantages	Relatively inexpensive. No new technology involved				
Disadvantages	Possible evolution of benzene from the grout matrix could cause an LFL problem. Leaching of material from the matrix may be a TCLP problem.				
Safety Issues	Possible buildup of benzene vapors from the grout reaching LFL levels				
Permitting Issues	Disposal of high level radioactive waste by this method likely not permitted. Would require extensive re-negotiation with environmental authorities. May not be allowed under current law				
Interface Issues	Pathway to transfer waste into Tank 48 would need to be evaluated. Might require some diversion box work				
Technical Issues	Stability of phenylborates in grout would need to be evaluated				
Technical Maturity	High				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	25	**Sponsor**	Dan Lambert	**Date**	1-17-2002
Title	Use an Outside vendor for disposal				
Description	Find an outside vendor (such as an incinerator vendor) and use the vendor's equipment to decompose or incinerate TPB.				
Advantages	1. Would be cheaper than building a new facility.				
Disadvantages	1. This is likely to be expensive. 2. This may lead to liability issues. 3. It may lead to pretreatment (removal of radioactivity) prior to acceptance by vendor. 4. The vendor may want to return the residue. 5. Transportation of slurry (40-60 tanker trucks?) will be difficult. It almost would have to be done at site. 6. If the vendor brings equipment on site, how will it be decontaminated or disposed of? 7. As with any process done outside of Tank 48, there will likely be a significant heel left in Tank 48.				
Safety Issues	1. How would a vendor safely handle the radioactive slurry? 2. How would the vendor prevent an explosion or radioactive release during processing?				
Permitting Issues	1. Permit will depend on vendor's processing. 2. A new permit will likely be required.				
Interface Issues	1. What will be done with vendor's residue? How will it be transferred to DWPF? 2. How will the slurry be transferred to the vendor's facility?				
Technical Issues	This would depend on the vendor's process and equipment.				
Technical Maturity	Medium				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	26	**Sponsor**	Peters	**Date**	1-21-2002
Title	Metathesize with cold cesium				
Description	A certain amount of Cs-137 is locked up in the solid CsTPB. If we can find a way to release the Cs-137 into the supernatant liquid, the liquid could be decanted and removed to other tanks. It may be possible to metathesize (exchange) the Cs-137 with Cs-133 that we add. The exchange should be thermodynamically neutral, and only kinetic factors should influence the rate of exchange. Removal of most of the Cs-137 might allow the remaining solids to be treated in the same way Tank 49H was treated.				
Advantages	This is a very simple process; a cold cesium salt is added and the tank mixed.				
Disadvantages	The exchange might be slow. This is not a complete solution by itself.				
Safety Issues	If successful, the supernatant liquid will show a great increase in beta-gamma activity				
Permitting Issues	None known				
Interface Issues	If the increased activity supernatant is pumped to another tank, is the shielding adequate.				
Technical Issues	A very simple process				
Technical Maturity	None. A test to determine if this can work should be quite simple.				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	27	**Sponsor**	R. C. Fowler	**Date**	1-14-2002
Title	Add Tank 48 Contents to Tank 49				
Description	Transfer the contents of Tank 48 to Tank 49 thus freeing up the space in Tank 48 for use				
Advantages	None.				
Disadvantages	No net benefit. The phenylborate material in Tank 49 has been destroyed and the material was transferred to Tank 50 for eventual disposal in Saltstone. Tank 49 has since been returned to Tank Farm service. Moving the Tank 48 material to Tank 49 would remove Tank 49 from Tank Farm service again. Would still have to deal with TPB left in heel of Tank 48 and the phenylborates transferred to Tank 49.				
Safety Issues	1. Tank 49 is covered under the Tank Farm SAR. A large quantity of organic material is not allowed by the Tank Farm SAR. The AB would need modification to permit this action. 2. Tank 49 does contain the necessary equipment to inert the tank with nitrogen. This equipment would need to be maintained to the appropriate safety classification if the material was transferred.				
Permitting Issues	None. Tank 49 previously contained phenylborate compounds similar to those currently in Tank 48 and this alternative would be covered under existing permits.				
Interface Issues	Because Tank 49 has been re-established as part of the H Area Tank Farm, this alternative would impact the Tank Farm and DWPF Waste Acceptance Criteria. A solution would be to isolate Tank 49 from the rest of the tank farm, as Tank 48 is isolated currently.				
Technical Issues	None				
Technical Maturity	This alternative only requires transferring material through existing pumps and lines and therefore is very mature technology.				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	28	**Sponsor**	R. C. Fowler	**Date**	1-14-2002
Title	Send to Containment Facility				
Description	Reduce the volume of the slurry in Tank 48 through filtration, evaporation, or other process and package the remaining material to be disposed of in an containment facility onsite (i.e. Solid Waste vaults).				
Advantages	Returns Tank 48 to Tank Farm service				
Disadvantages	1. Doesn't permanently dispose of the organic material, only changes the storage location 2. Requires personnel to handle significant quantity of high level waste 3. Presents a flammable vapor hazard to the storage facility				
Safety Issues	Potential flammable hazard for the storage facility Personnel exposure from high level waste				
Permitting Issues	No facility exists onsite that is permitted for this type of waste. Extensive permit revisions would be required				
Interface Issues	None				
Technical Issues	Handling and transport of the highly radioactive material would present a challenge from a personnel safety standpoint.				
Technical Maturity	Low, this operation would be a new initiative onsite.				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative #	29	**Sponsor**	Peters	**Date**	1-21-2002
Title	Remove supernate and react phenylborate heel in solvent				
Description	The supernate liquid can be removed, leaving a TPB heel. The insoluble heel will not react quickly unless solubilized. It may be possible to locate an appropriate solvent to dissolve the heel, such a perflourocarbon. Once dissolved, the material can be reacted more easily.				
Advantages	Keeps the process in the tank.				
Disadvantages	Addition of a new chemical. This is not a complete solution in and of itself.				
Safety Issues	Adding a new chemical to the tank				
Permitting Issues	Adding a new chemical to the tank				
Interface Issues					
Technical Issues	Need to locate a suitable candidate solvent.				
Technical Maturity	Not tried on site.				

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative # 30	**Sponsor:** R. C. Fowler	**Date:** 1-14-2002
Title	Evaporate to Dryness and Bury or Add to Grout	
Description	Evaporate the material in Tank 48 to dryness and dispose of the resulting material as solid waste. The dried material could be added to grout and disposed of at Saltstone or in a decommissioned tank or transferred to the E Area vaults. The evaporation process would likely take place outside Tank 48. And require a shielded facility.	
Advantages	Smaller volume to dispose of. Complete recovery of Tank 48 space.	
Disadvantages	Storage of the dried material in the E Area vaults would not be a permanent solution	
Safety Issues	Radiological content may be to high for Saltstone, a grouted tank or the E Area vaults.	
Permitting Issues	Neither Saltstone, decommissioned tanks nor the E Area vaults are permitted to take precipitate waste in these quantities	
Interface Issues	Transportation. The material would be highly radioactive.	
Technical Issues	Precipitate may be difficult to dry without decomposing.	
Technical Maturity	Low, the difficulty of drying this material is unknown	

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative # 31	**Sponsor:** R. C. Fowler	**Date:** 1-14-2002
Title	Develop Method to Stabilize Material and Use Tank 48 "As-is"	
Description	Develop an additive or a processing method to render the phenylborate material stable from decomposing such as removing the mercury from the tank or the addition of sulfide. Then use Tank 48 for receiving fresh radioactive waste.	
Advantages	Mostly performed in-tank. Relatively simple.	
Disadvantages	Phenylborates are not destroyed and may prove to be a problem for the eventual salt processing process.	
Safety Issues	Need assurance of the long-term stability of the phenylborate compounds. Their decomposition would impact LFL.	
Permitting Issues	A new chemical addition to the waste tanks would require a review of impacts to the current permits.	
Interface Issues	None	
Technical Issues	Development of a stability reagent	
Technical Maturity	Low.	

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative # 32	**Sponsor:** R. C. Fowler	**Date:** 1-14-2002
Title	Pyrolytic Decomposition of Precipitate	
Description	Develop a process to decompose the phenylborate compounds using heat. Material from Tank 48 would be pumped from the tank and processed at high temperature to break down the organic chemical. The remaining radioactive inorganic material would be incorporated into Tank Farm storage. Tank 48 would then be returned to Tank Farm service. The thermal degradation facility could be small enough to locate in the ITP filter cell area.	
Advantages	Would rid Tank 48 of unwanted organic material. Could use existing ITP filter building ventilation system to vent resulting benzene.	
Disadvantages		
Safety Issues	High temperature processing would need to be evaluated in the Authorization Basis.	
Permitting Issues	Benzene release rates from the new process would need to be reviewed against the current ITP air permits.	
Interface Issues	Transfer paths between Tank 48 and the filter building would need to be re-established.	
Technical Issues	New process. Operating parameters need to be developed.	
Technical Maturity	Low	

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative # 33	**Sponsor: R. A. Adams**	**Date:1-16-2002**
Title	Tank 49 as a reaction vessel	
Description	Feed a predetermined amount of sludge to tank 49 to act as a catalyst. Feed a predetermined amount of tank 48 slurry to tank 49. Plot the gas generation rate and determine the half-life. At the end of the 2nd or 3rd half-life pump 49 back to 48 and observe the gas generation half-life. If the same as tank 49 prior to pumping, the reaction rate is determined. Continue to feed sludge to tank 49 and add slurry from tank 48; allow reaction and return to tank 48. If volumes of slurry and sludge remain approximately equal per cycle the observed gas generation rate should decrease at each cycle. Once determined, the volumes could be increased.	
Advantages	No new equipment or facilities. All reactions take place in tanks that have a nitrogen purge capability. Reaction rate can be controlled and bracketed by sludge/ slurry volume. Uses the same reasoning as used in the recovery of tank 49.	
Disadvantages	Loss of emergency space for tank 48 by the addition of sludge.	
Safety Issues	Inability to predict the gas generation rates due to inconsistent concentration of elements/compounds.	
Permitting Issues	None	
Interface Issues	Sludge in tank 49.	
Technical Issues	Low volume transfers between tank 48 & 49.	
Technical Maturity	Proven on tank 49 with Cu catalyst.	

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative # 34	**Sponsor:** Dan Lambert	**Date:** 1-17-2002
Title	Use solvent to extract KTPB, park solvent/TPB in unused waste tank.	
Description	Extract the KTPB with a lower density solvent. Decant the lower density solution (estimated volume ~10,000 gallons) and pump to another waste tank (such as a leaking waste tank). The solution will be processed at a later date. The resulting supernate can be fed to Saltstone.	
Advantages	1. Would need to resolve DNFSB 96-1 issues prior to commencing processing. 2. Would be cheaper than many of the options. 3. The KTPB would be completely removed from the Tank (as clean as practical). Virtually all other options will leave a significant residue of organics in Tk 48. 4. No new facility would be required to return Tank 48 to service. 5. The supernate left in the tank would be fed to Saltstone.	
Disadvantages	1. A process will have to be developed later to dispose of the TPB and solvent. 2. If the new TPB storage tank leaked, it would be irresponsible to have moved it. 3. Would need to inert the new tank where the solvent and TPB will be stored. 4. Would need to set up a sampling protocol for the new tank.	
Safety Issues	Would need to develop a solvent that will not lead to flammability issues.	
Permitting Issues	A benzene permit will be required for the new TPB storage tank.	
Interface Issues	How will the slurry be safely transferred to the new tank?	
Technical Issues	What is the decomposition rate of the TPB in the new solvent? Can a safe solvent be found that would not impact further processing?	
Technical Maturity	Low	

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative # 35	**Sponsor:** R. A. Adams	**Date:** 1-28-2002
Title	Actinide Removal Process (ARP) Using Permanganate	
Description		
Advantages	There would not be a special process for tank 48.	
Disadvantages	The process of breaking down the organics may not be fast enough to support the flow sheet requirements for ARP.	
Safety Issues	The feeding of tank 48 contents to the ARP or blend tank may cause the generation of benzene.	
Permitting Issues	Should be covered under current permits.	
Interface Issues	This would enhance the interface by allowing tank 48 to become the feed tank to the ARP.	
Technical Issues	Lab tests will be required to demonstrate the decomposition of organics and to identify reaction rates.	
Technical Maturity		

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative # 36	**Sponsor:** R. A. Adams	**Date:** 2-5-2002
Title	Tank in Tank	
Description	Through a riser opening insert a tank the height of tank 48 and the diameter of the riser opening. The tank would be valved near the bottom to allow flow into the tank. In the tank there would be a submergible pump to pump treated waste to tank 49 via flex hose. In process could be used in the tank because the reaction process would be limited to the capacity of the inner tank.	
Advantages	The technology is simple, the cost is small and the reaction rates controllable.	
Disadvantages	The process of breaking down the organics may not be fast enough to support flow sheet requirements.	
Safety Issues	The feeding of solvent, catalyst, etc. to tank 48 contents, even a 2k-gallon tank will cause the generation of benzene.	
Permitting Issues	Should be covered under current permits.	
Interface Issues	The process would be limited to the East Hill.	
Technical Issues	Lab tests will be required to demonstrate the decomposition of organics and to identify reaction rates.	
Technical Maturity		

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative # 37	**Sponsor:** Jerry Morin	**Date:** 2-5-2002
Title	Microwave Destruction Of Organics	
Description	Employ a tuned microwave system to irradiate the slurry in Tank 48 to reduce the organic phenylborate species to water and carbon dioxide or to organic levels, which can be safely dispositioned in other waste tanks. Such a system could be installed within a Tank-In-Tank vessel in one of the 24-inch risers. The electronics, controls etc would be outside the tank and the microwaves would pass through waveguides into the tank vessel.	
Advantages	The technology has been shown for other organics, including benzene and the process is controllable. SRTC owns several patents and George Wicks is the expert on microwave destruction of the organics	
Disadvantages	The process of breaking down the organics may not be complete enough to satisfy allowable organic levels in other tanks.	
Safety Issues	The process may form some intermediates including benzene.	
Permitting Issues	Should be covered under current permits.	
Interface Issues	The process would be limited to the East Hill. Dispositioned waste would go to other waste tanks.	
Technical Issues	Lab tests will be required to demonstrate the decomposition of organics and to identify reaction rates.	
Technical Maturity	Medium	

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative # 38	**Sponsor:** Pat Suggs	**Date:** 1/9/02
Title	Volume-Reduce by filtration, sending filtrate to Tank 49/50, Decompose residual in-tank	
Description	Send filtrate to Tank 50, if necessary breaking into 2 batches (current Tk 50 inventory -- plus next generation Tank 50 inventory) Reduce free hydroxide of the residual contents (minimum level required to allow pump mixing) to the lowest hydroxide level possible, (~pH 10), which still within the tank corrosion guidelines (Tank 49 reached fairly low hydroxide levels). Historical research reports (WSRC –TR's 97-0285; 97-0073; 98-0070; 2000-459; and MS-97-0363) indicate tetraphenylborate decomposition is related to the quantity of sludge present. The decomposition of the contents of Tk 48 (under nitrogen) may be accomplished by agitating in the presence of 2.5 g/L_of sludge added from elsewhere in the tank farms, or by commercially procured nickel catalyst. (Nickel is immediately above palladium on the periodic table, and is present in much greater quantities in our sludge than palladium, also used in the petroleum/food industry as a hydrogenation catalyst). The rate of decomposition should be temperature-controllable by adjusting the frequency/duration of pump runs. After decomposition is essentially complete, one option is to strike the decomposed material with formate and permanganate to convert any unreleased benzene to phenol, which is not a flammability concern to us. Allowing us to transfer the contents to the tank farm if desired (Re-filter, sending sludge to Tank 51, clarified supernate to Tank 49).	
Advantages	Fast, cheap, requiring no new infrastructure, uses existing pumps, nitrogen system	
Disadvantages	Like other options, would require lab studies to support safety basis documentation of rates of reaction, similar to Tank 49 requirements. Releases carcinogenic benzene via the HEPA filters, though the possibility of decomposing in the presence of NaMnO4/formate could be investigated	
Safety Issues	The in-place nitrogen system helps address the safety issues, the avoidance of any new tie-ins helps avoid flammable, vapor leaking concerns	
Permitting Issues	Saltstone WAC. The current criteria are very restrictive, low curie salt (saltcake draining/dissolution) seeks to raise the existing allowable cesium level. The initial filtration could be performed in 2 batches, the first batch to the current contents of Tank 50.	
Interface Issues	Interfaces required with SRTC, WSMS, DNFSB, etc	
Technical Issues	Lab studies required with simulants to measure reaction rates with temperature, and effectiveness of permanganate/formate for benzene conversion	
Technical Maturity	See technical reports. As mature as possible considering the 96-1 Research Program did not establish a repeatable relationship with a single catalyst such as palladium	

HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative # 39	**Sponsor:** Jerry Morin	**Date:** 2/6/02
Title	Steam reforming / fluidized bed	
Description	This is a thermal treatment process presently commercialized. A versatile technology that can not only provide heat for a chemical oxidation reaction, similar to that of an incinerator, but it can also control process chemistry. It is used for organic destruction, conversion of materials, and the destruction of nitrates.	
Advantages	Several vendors supply the system in several large projects. The system has been reviewed for use at SRS. Can be tied to the front end of an existing or planned facility.	
Disadvantages	Process is privately owned therefore will require an out side contractor.	
Safety Issues	May require AB effort.	
Permitting Issues	May require a change to current permits.	
Interface Issues	If added to the flow sheet for a planned project it may be easy. As an addition to an existing facility, it would probably be a major outage effecting production.	
Technical Issues		
Technical Maturity	Medium	

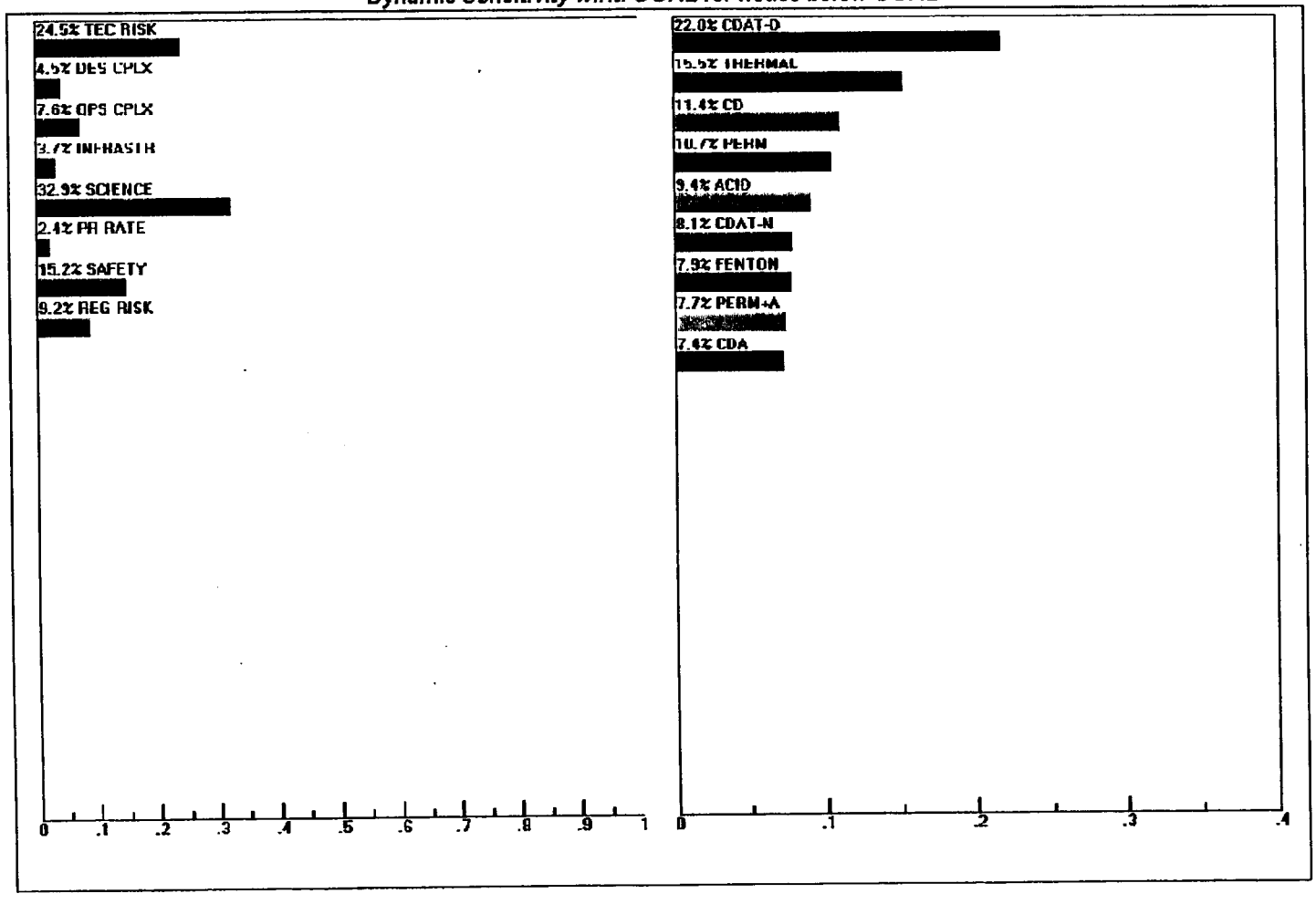
HLW TANK 48 ALTERNATIVE DATA SHEET

Alternative # 40	**Sponsor:** R. A. Adams	**Date:** 1/28/02
Title	MST / TPB strike in the flow sheet for the HLW system	
Description	Utilize a front-end process that adds monosodium titanate (MST) to incoming waste to absorb strontium and actinides and tetraphenylborate (TPB) to capture the Cs. The addition of a process similar to the Salt Cell concept added to the Small Tank flow sheet could be added to the low curie, actinide removal or the caustic side solvent extraction (CSSX) flow sheets as part of an overall waste treatment flow sheet. Tank 48 could be processed through the system as it currently exists.	
Advantages	There would not be a special process for tank 48. The process is well understood and significant work has been completed as part of the Alt Salt Program.	
Disadvantages	The process of breaking down the organics may not be fast enough to support the flow sheet requirements using tank 48 as a sole feed tank (may have blend which will require additional waste to be added to tank 48.	
Safety Issues	The feeding of tank 48 contents to the system or blend tank may cause the generation of benzene.	
Permitting Issues	Should be covered under current permits.	
Interface Issues	This would enhance the interface by allowing tank 48 to become the feed tank to the system.	
Technical Issues	96 - 1 requirements	
Technical Maturity	High	

Attachment 3 – Ecpro Output

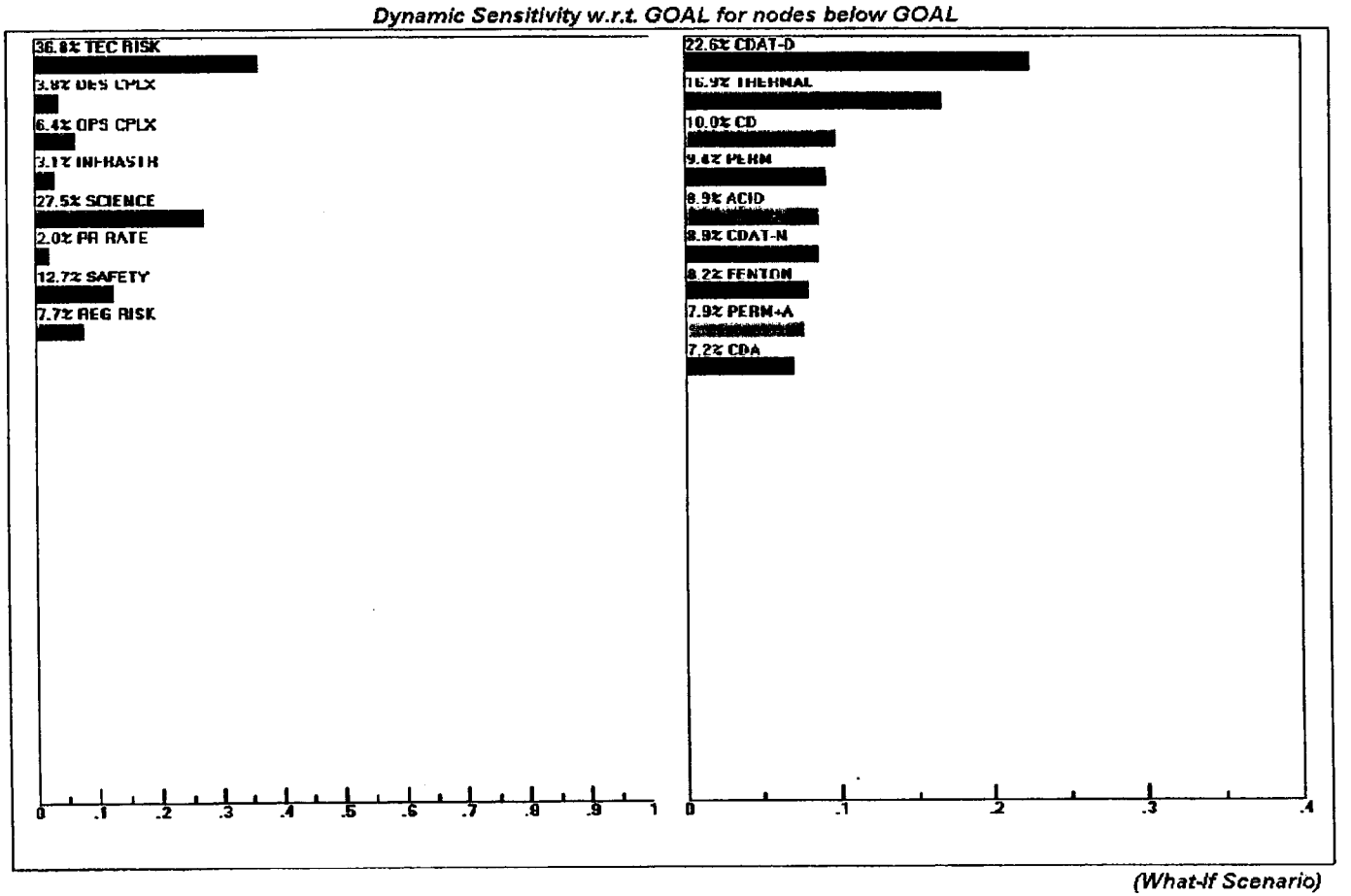
3-1 – Results

Dynamic Sensitivity w.r.t. GOAL for nodes below GOAL



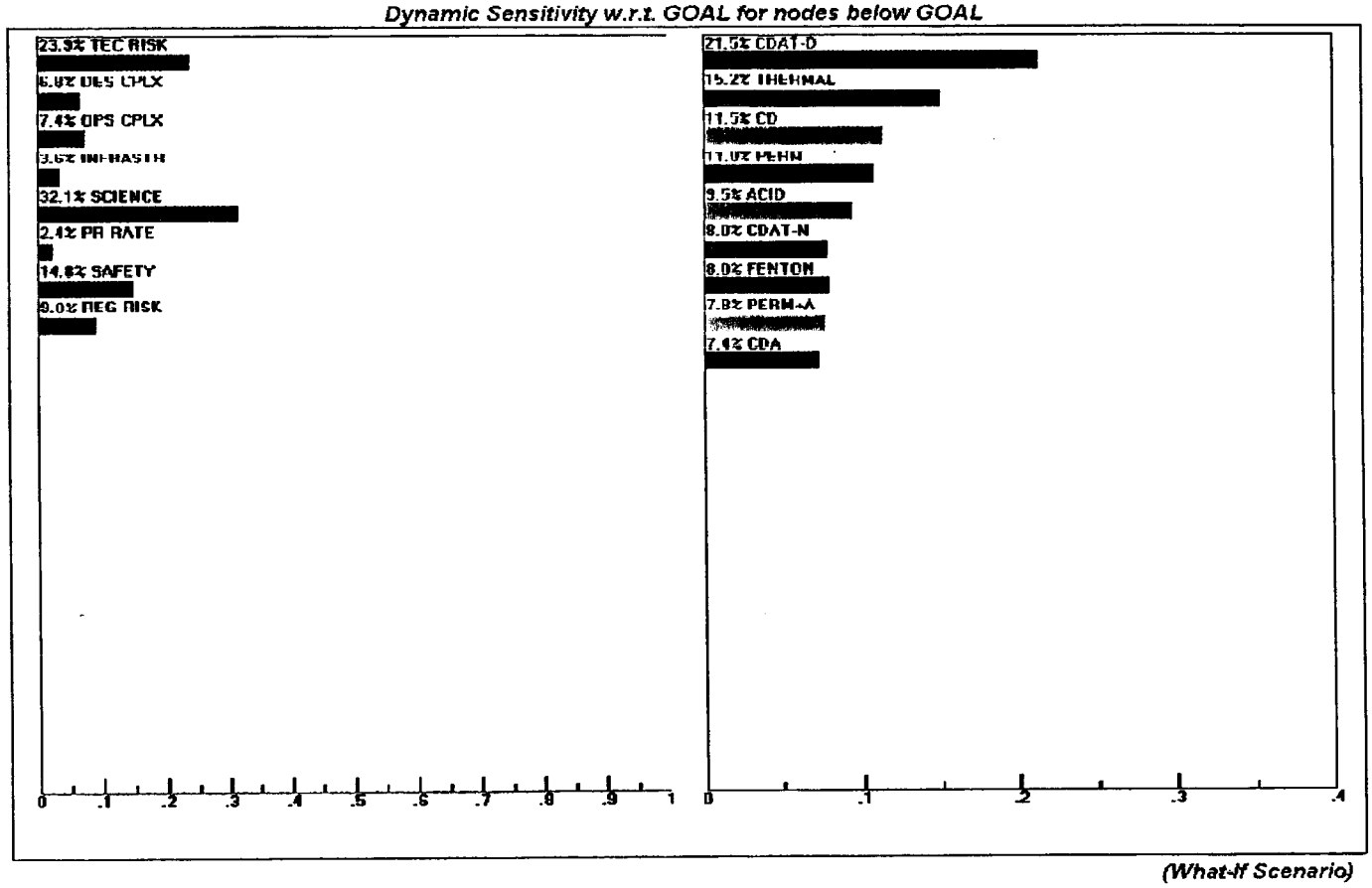
LEGEND: CDAT-D – Salt Cell Process; THERMAL – Thermal decomposition; CD – Catalytic Decomposition; PERM – Permanganate; ACID – Acid only; CDAT-N – Catalytic Decomposition in New Facility; FENTON – Fenton's Reagent; PERM+ACID – Permanganate + Acid; CDA – Catalytic Decomposition with Acid

Attachment 3 – Ecpro Output
3-2 – Results (Technical Risk wt +50%)



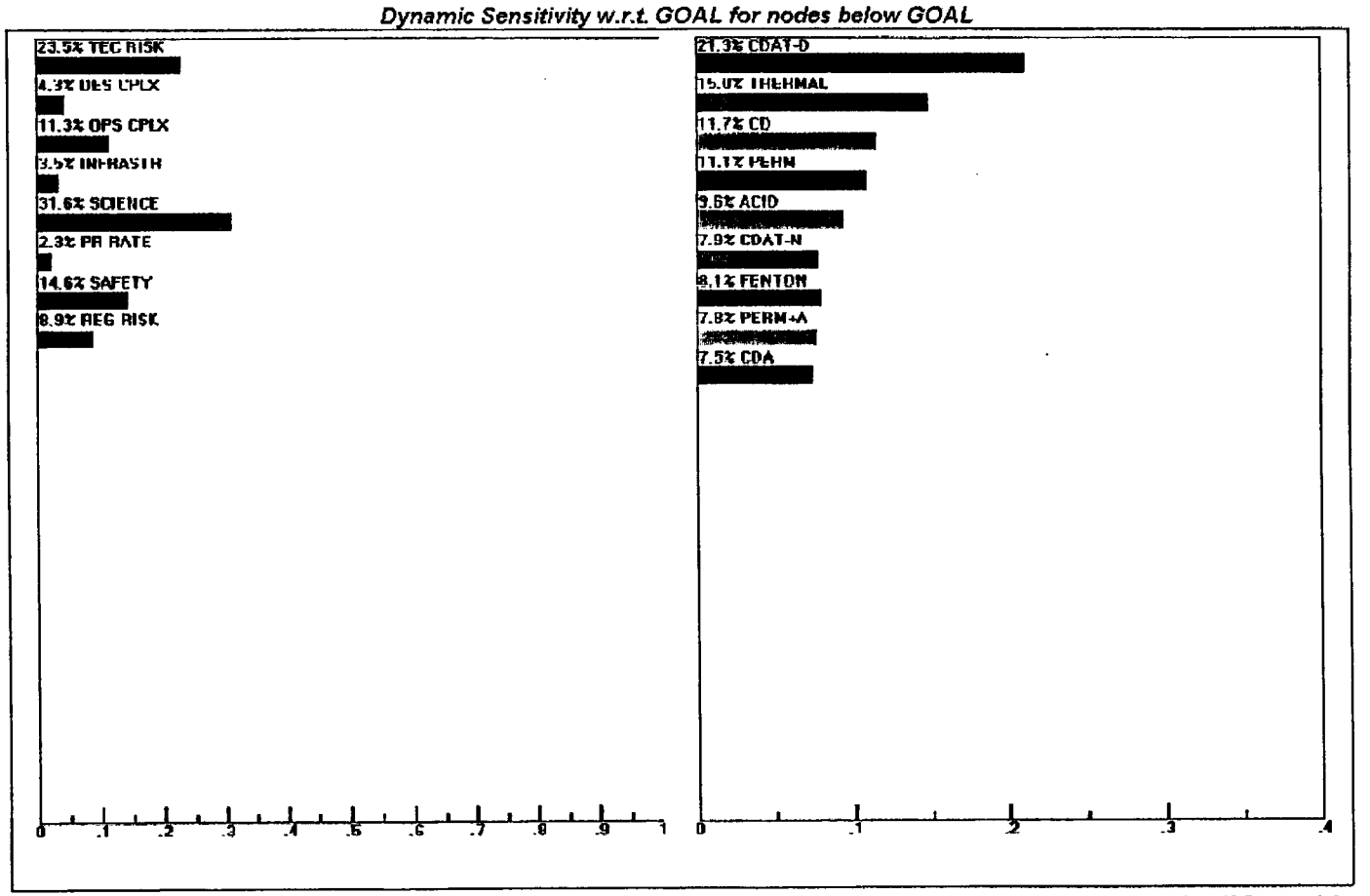
LEGEND: CDAT-D – Salt Cell Process; THERMAL – Thermal decomposition; CD – Catalytic Decomposition; PERM – Permanaganate; ACID – Acid only; CDAT-N – Catalytic Decomposition in New Facility; FENTON – Fenton's Reagent; PERM+ACID – Permanganate + Acid; CDA – Catalytic Decomposition with Acid

Attachment 3 – Ecpro Output
3-3 – Results (Design Complexity wt +50%)



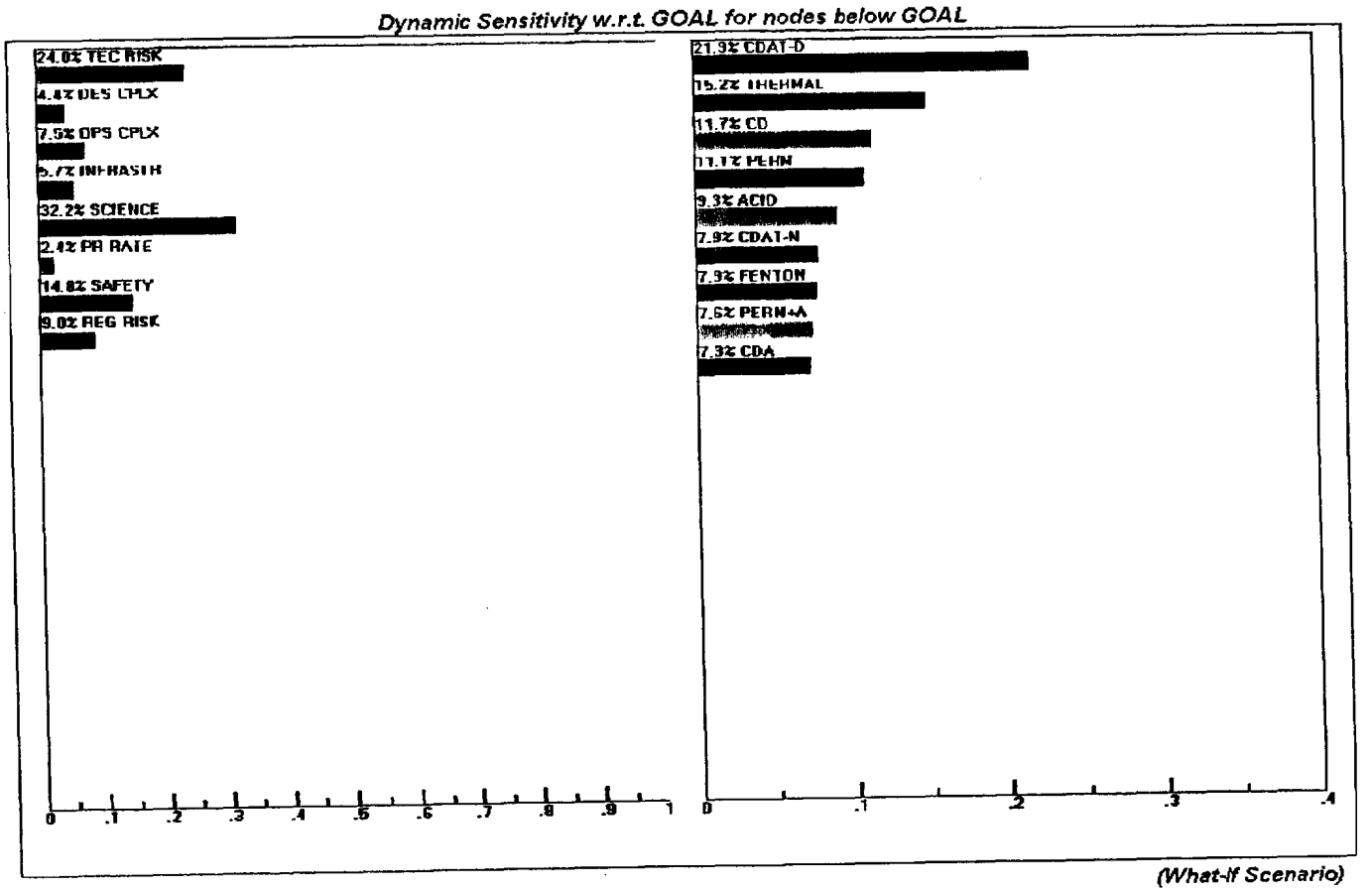
LEGEND: CDAT-D – Salt Cell Process; THERMAL – Thermal decomposition; CD – Catalytic Decomposition; PERM – Permanganate; ACID – Acid only; CDAT-N – Catalytic Decomposition in New Facility; FENTON – Fenton's Reagent; PERM+ACID – Permanganate + Acid; CDA – Catalytic Decomposition with Acid

Attachment 3 – Ecpro Output
3-4 – Results (Operational Complexity wt +50%)



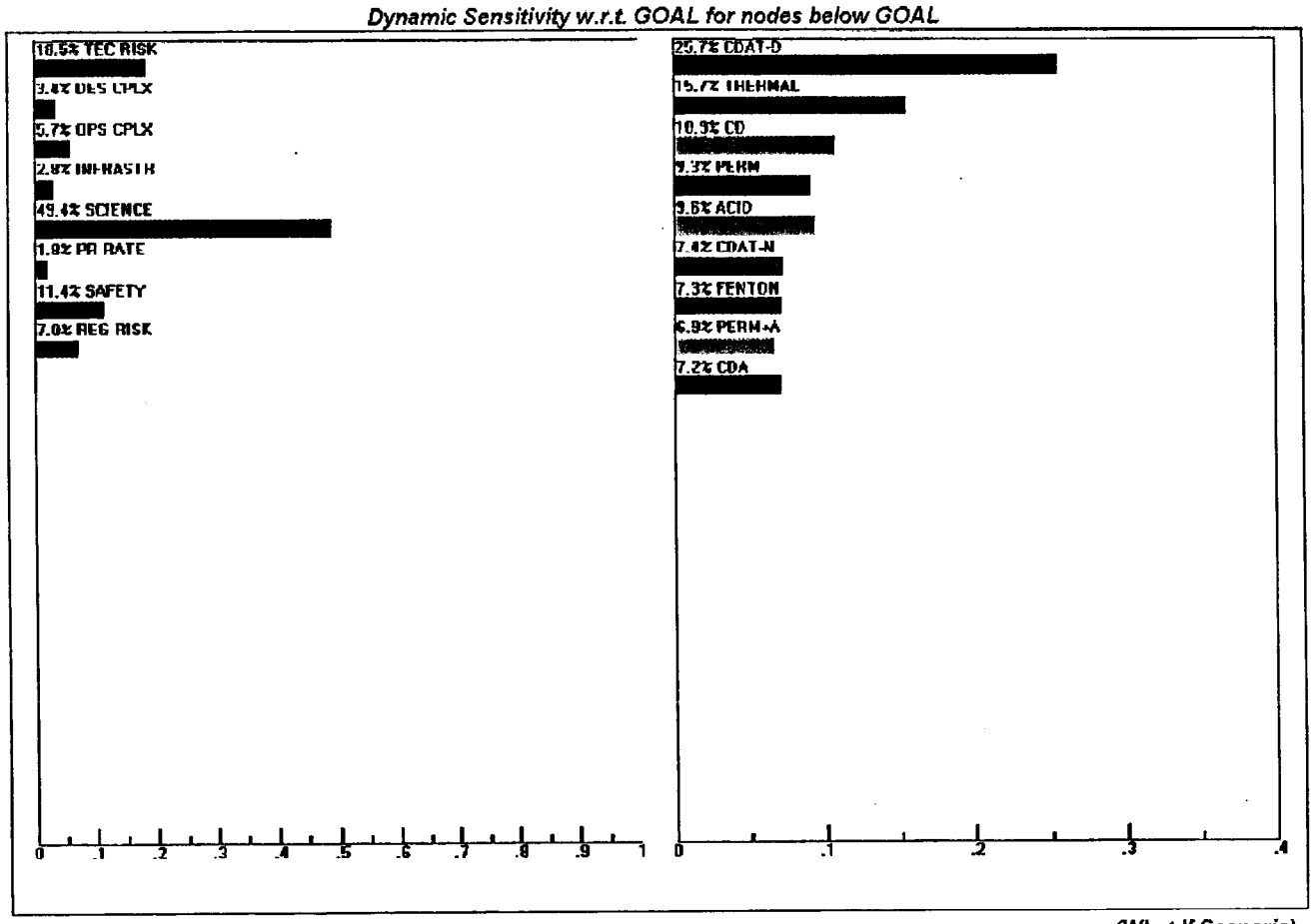
LEGEND: CDAT-D – Salt Cell Process; THERMAL – Thermal decomposition; CD – Catalytic Decomposition; PERM – Permanganate; ACID – Acid only; CDAT-N – Catalytic Decomposition in New Facility; FENTON – Fenton's Reagent; PERM+ACID – Permanganate + Acid; CDA – Cataleptic Decomposition with Acid

Attachment 3 – Ecpro Output
3-5 – Results (Infrastructure wt +50%)



LEGEND: CDAT-D – Salt Cell Process; THERMAL – Thermal decomposition; CD – Catalytic Decomposition; PERM – Permanganate; ACID – Acid only; CDAT-N – Catalytic Decomposition in New Facility; FENTON – Fenton's Reagent; PERM+ACID – Permanganate + Acid; CDA – Catalytic Decomposition with Acid

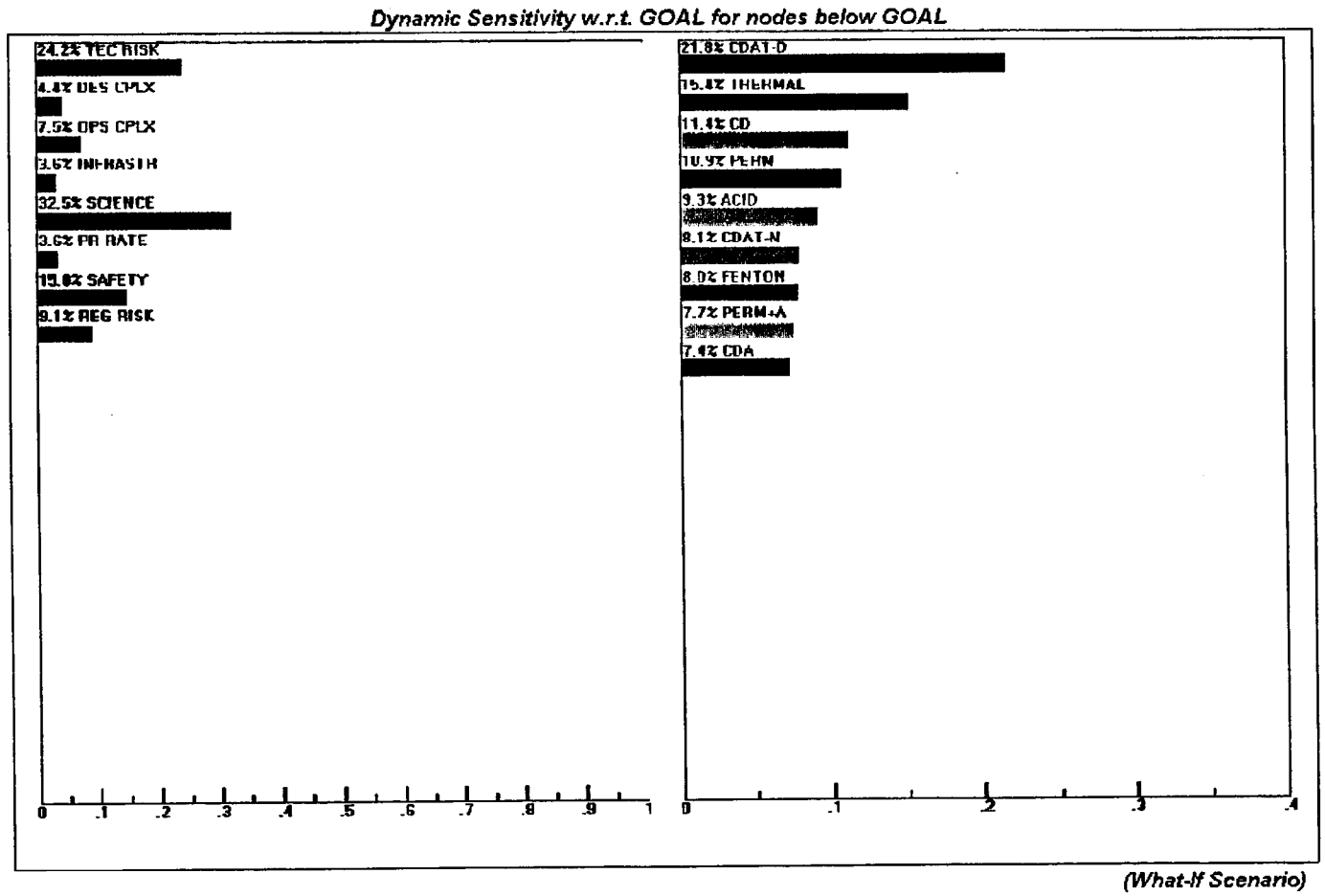
Attachment 3 – Ecpro Output
3-6 – Results (Science wt +50%)



(What-If Scenario)

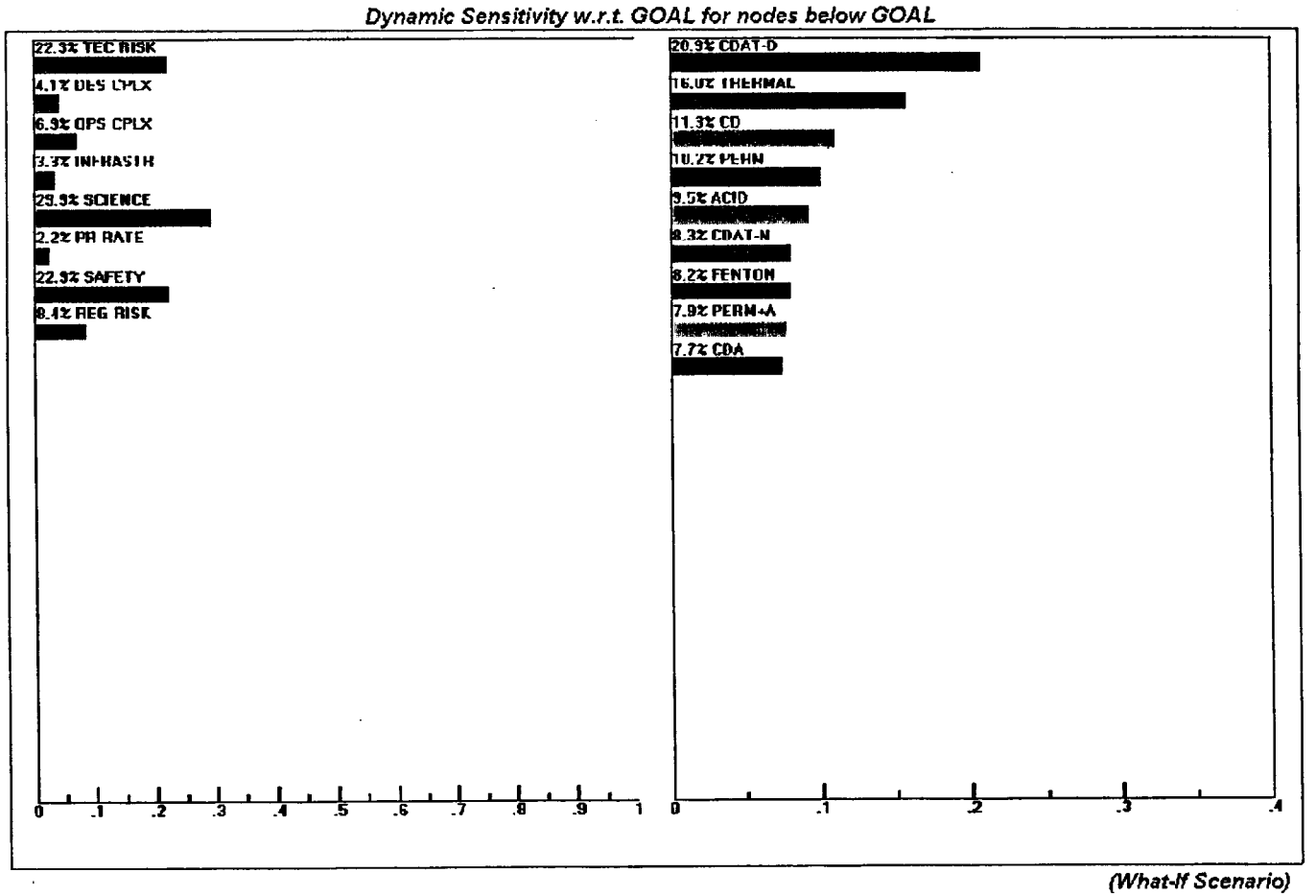
LEGEND: CDAT-D – Salt Cell Process; THERMAL – Thermal decomposition; CD – Catalytic Decomposition; PERM – Permanganate; ACID – Acid only; CDAT-N – Catalytic Decomposition in New Facility; FENTON – Fenton's Reagent; PERM+ACID – Permanganate + Acid; CDA – Catalytic Decomposition with Acid

Attachment 3 – Ecpro Output
3-7 – Results (Process Rate wt +50%)



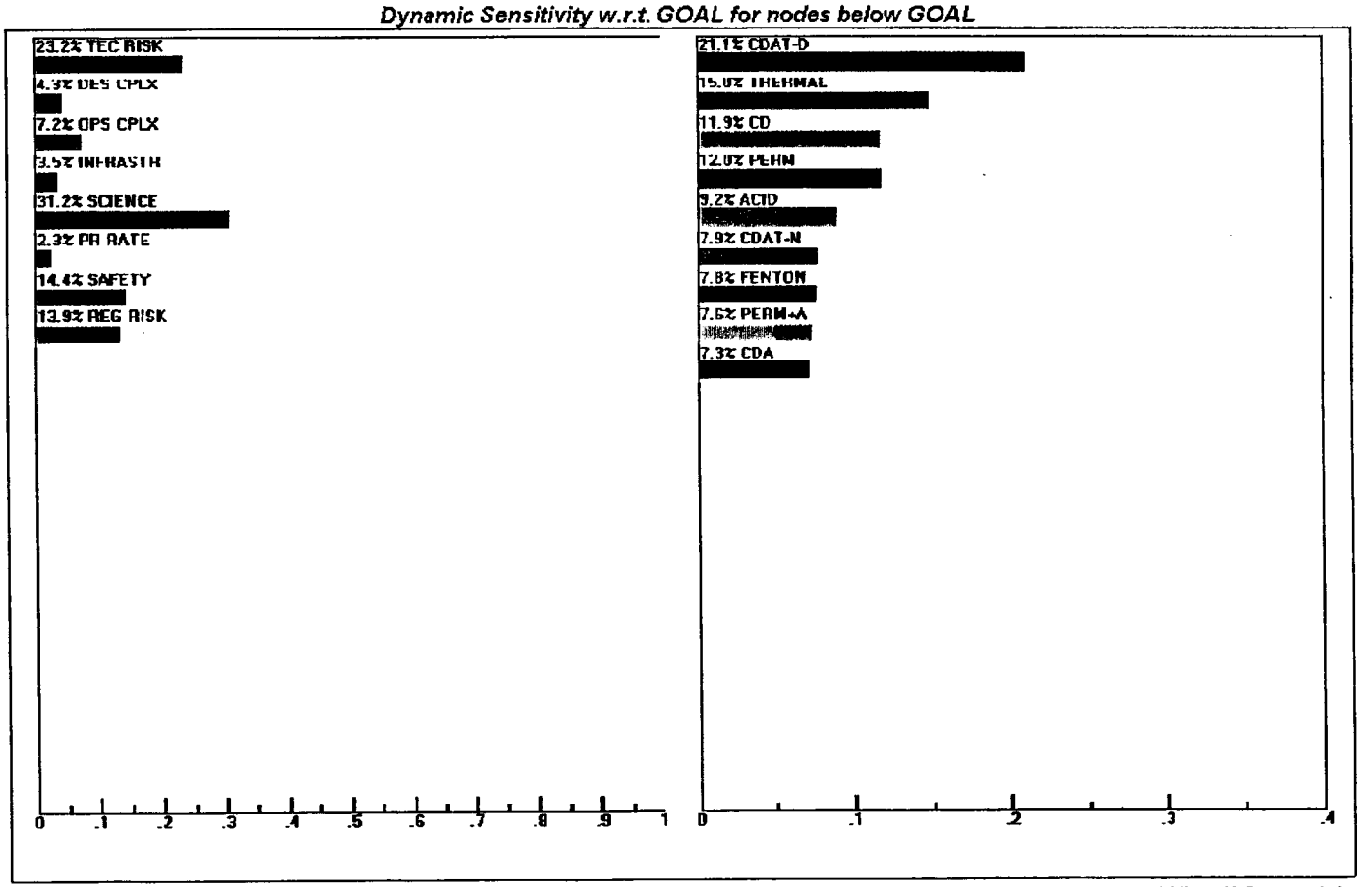
LEGEND: CDAT-D – Salt Cell Process; THERMAL – Thermal decomposition; CD – Catalytic Decomposition; PERM – Permanganate; ACID – Acid only; CDAT-N – Catalytic Decomposition in New Facility; FENTON – Fenton's Reagent; PERM+ACID – Permanganate + Acid; CDA – Catalytic Decomposition with Acid

Attachment 3 – Ecpro Output
3-8 – Results (Safety wt +50%)



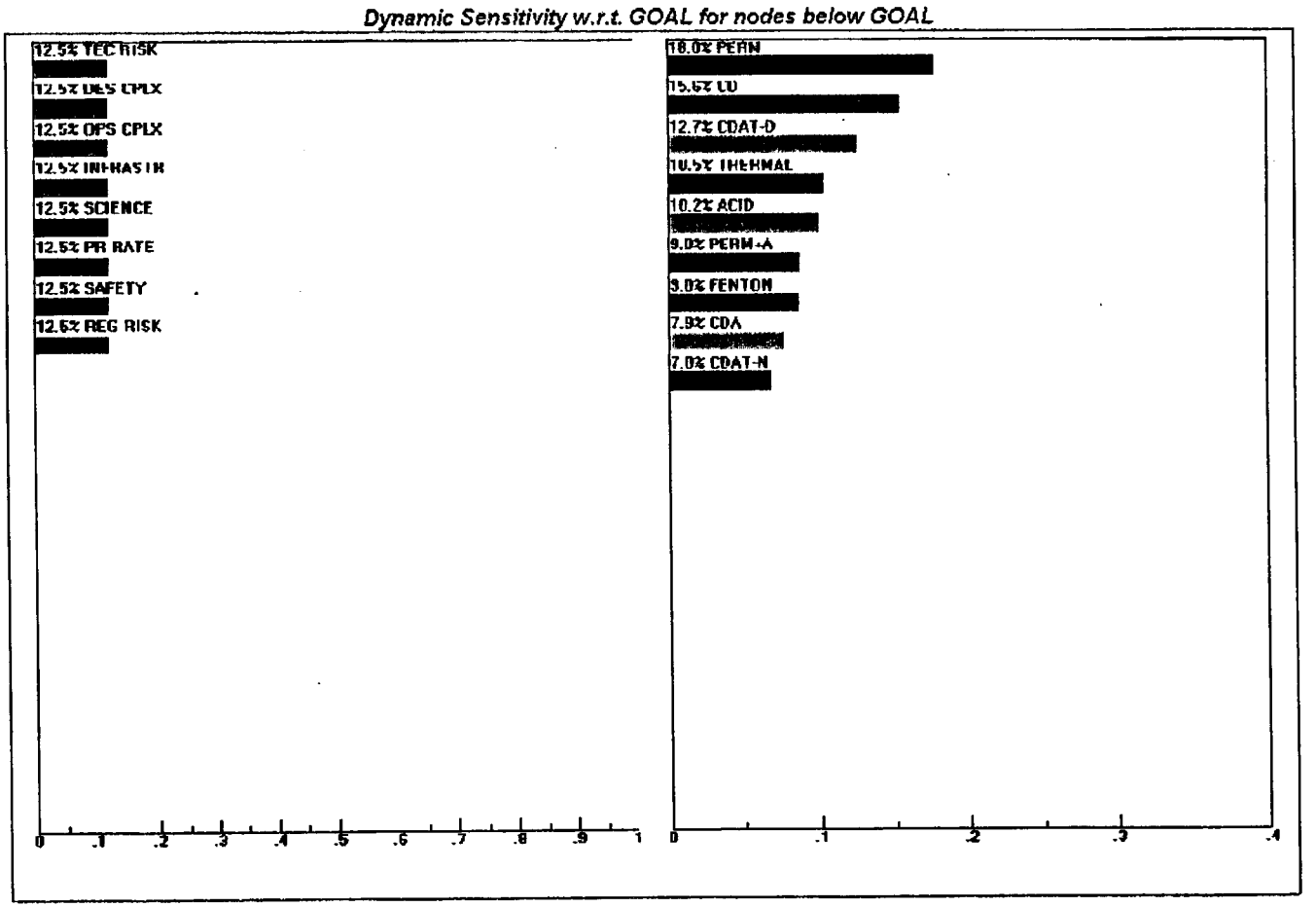
LEGEND: CDAT-D – Salt Cell Process; THERMAL – Thermal decomposition; CD – Catalytic Decomposition; PERM – Permanganate; ACID – Acid only; CDAT-N – Catalytic Decomposition in New Facility; FENTON – Fenton's Reagent; PERM+ACID – Permanganate + Acid; CDA – Catalytic Decomposition with Acid

Attachment 3 – Ecpro Output
3-9 – Results (Regulatory wt +50%)



LEGEND: CDAT-D – Salt Cell Process; THERMAL – Thermal decomposition; CD – Catalytic Decomposition; PERM – Permanganate; ACID – Acid only; CDAT-N – Catalytic Decomposition in New Facility; FENTON – Fenton's Reagent; PERM+ACID – Permanganate + Acid; CDA – Catalytic Decomposition with Acid

Attachment 3 – Ecpro Output
3-10 – Results (All weights equal)



LEGEND: CDAT-D – Salt Cell Process; THERMAL – Thermal decomposition; CD – Catalytic Decomposition; PERM – Permanganate; ACID – Acid only; CDAT-N – Catalytic Decomposition in New Facility; FENTON – Fenton's Reagent; PERM+ACID – Permanganate + Acid; CDA – Catalytic Decomposition with Acid

Appendix 1 -Charter

It has been determined that the contents of Tank 48H are not compatible with the existing HLW process and require disposition to allow Tank 48H to be returned to service. The SRS HLW Tank 48 Disposition Team is charged with the task of systematically developing and recommending a technology for disposition of Tank 48H contents. The alternative(s) selected for final recommendation will be capable of safely and cost effectively processing organics from SRS High Level Waste (HLW) Tank 48H.

Team participants will be selected based on their proven subject matter expertise, objectivity, open-mindedness and not being predisposed to a single technology. A listing of Team members is shown in Appendix 2. The Team members should have other resources available to them from their parent organization in order to facilitate the completion of assigned action items, research, report writing, etc. relevant to the Team Charter.

Further, the Team is to follow the Systems Engineering (SE) approach in developing alternatives. The SE approach has proven effective both at SRS and elsewhere when solving a large and/or technically complex problem such as we have before us. The SE approach starts with defining the "top down" functions and requirements any solution must meet including an assessment of need. The other salient features of this process include the definition of external interfaces, brainstorming alternatives, risk management and developing screening criteria, e.g. boundary conditions against which alternatives can be objectively evaluated for viability. The critical needs and minimum boundary conditions/constraints that all alternatives should be evaluated against are shown in Section 4.1. The Team will develop and work to a detailed System Engineering Management Plan (SEMP).

The deliverables provided by the Team are divided into two phases in order to allow transmittal of information to both internal and external review teams for feedback and concurrence purposes. The major milestones required of the Team are listed in Appendix 3

Completion of the HLW Tank 48 Disposition Team report and recommendation of a preferred alternative(s) meets the requirement of the HLW Tank 48 Disposition Team Charter.

Appendix 2 – Team members

PROJECT OWNER -- BOB ADAMS
Bob has an extensive background in Operations, Plant Maintenance and Project Management. His primary contribution to the Team will be maintaining a path forward that is compatible with accepted operating and maintenance requirements and guidelines.

PROCESS ENGINEERING MEMBER -- RICK FOWLER
Rick is a chemical engineer in Process Engineering section of the High Level Waste Division. Rick was a member of the engineering group for the testing and initial operation of the In-Tank Processing facility. He also has been involved in the development and testing of the Small Tank Tetraphenylborate candidate for the Alternative Salt process. Rick was also the lead chemical engineer for the Tank 49 remediation project.

SRTC ENGINEERING MEMBER -- DAN LAMBERT
Dan is a Chemical Engineer working in the Waste Processing Technology Section in the Savannah River Technology Center. Dan has extensive experience in the hydrolysis of TPB through his work with small scale research, pilot plant process development and was involved in the cold chemical startup of the TPB hydrolysis process in the Defense Waste Processing Facility. Dan has led the research/development to develop and improve the sludge-only chemical processing used to operate DWPF since radioactive startup. Dan is also involved in the development of improved antifoam formulations for DWPF and the Small Tank TPB process.

SRTC SCIENCE MEMBER -- TOM PETERS
Tom is a chemist working in Sam Fink's group in Waste Processing Technology at SRTC. Tom was the principle investigator in the Tank 49H remediation study and following tank cleanup (see Attachment 3). Another related project Tom worked on was the CSTR real waste demo (small tank) in 2001.

SAFETY & REGULATORY ENGINEERING MEMBER -- ROBERT BENTLEY
Bob has over 21 years of Licensing and Regulatory experience at several commercial nuclear power plants and DOE facilities, including Hanford, Yucca Mountain, Pantex and SRS. Bob served as the Nuclear Safety representative on a five-member team chosen by DOE-RL overseeing the development of the TWRS-EIS. Bob was also the principal author of the Authorization Basis that was approved for the disposition of Tank 49 waste material and was extensively involved in the development of the accident analysis supporting the safety basis. Bob is currently serving as a Deputy Manager at the Tank Farm for WSMS Regulatory Programs.

REGULATORY ENGINEERING MEMBER **NARINDER MALIK**

Narinder is an environmental scientist/engineer with the High Level Environmental Compliance Authority. Narinder has over 25 years experience in environmental compliance and regulatory analyses. Narinder has extensive experience in environmental compliance at SRS facilities, including DWPF, High Level Waste Tank Farm – H Area, Salt Waste Processing Facility, and Actinide Removal Process. Narinder has participated in the development of Functional Design Description (FDD) for a variety of projects at SRS. His primary responsibilities were to ensure that the facility design meets all applicable environmental regulatory requirements. He served as a lead, for a number of years, for environmental protection and waste management functional areas of the WSRC S/RID.

SYSTEMS ENGINEERING MEMBER -- GAVIN WINSHIP

Gavin is a Systems Engineer working in the PE&CD Systems Engineering Department. Gavin has over 20 years experience working in commercial and government nuclear facilities in the US and overseas. Gavin has extensive experience in the application of Systems engineering at SRS facilities including DWPF, ITP, Salt Waste Processing Facility, Actinide Removal Process and has facilitated, participated and supported alternative evaluations, design reviews, functional analysis and requirement development within the HLW Division.

DESIGN AUTHORITY MEMBER -- MICHAEL NORTON

Mike is a B.S. Chemical Engineer working in the High level Waste Engineering Organization. He has over 11 years experience in the High Level Waste Division as a Design authority Engineer and a Design Authority Engineering Manager. His current assignment is the Design Authority Engineering Manager for the Actinide Removal Project.

HLWE SENIOR TECHNICAL ADVISOR -- JERRY MORIN (Phase 1)

Jerry is a Ph.D. Chemical Engineer working in the High Level Waste Engineering Division. Jerry has over 30 years experience at SRS working in nuclear reactors and high level waste programs including ITP, Salt Waste Processing and as Program Manager for the Alt Salt Program during the DOE baseline process selection.

CHEMISTRY ADVISOR -- JAMES BONCELLA

Jim is a Ph. D. Chemist and Professor at the University of Florida.

Appendix 3- Team Milestones

PHASE		DELIVERABLE	DATE
1	•	Team Selection	12/13/01
	•	Systems Engineering Management Plan	1/30/02
	•	Approval of Screening Criteria	2/20/02
	•	Report Documenting the Activities Leading to an "initial List" of Alternatives	2/28/02
2	•	Develop Task Technical and Quality Assurance Plan for Scoping Studies	3/26/02
	•	Develop/Schedule Activities Leading to a "Short List" of Alternatives	3/27/02
	•	Approve Selection Criteria	4/21/02
	•	Provide Report on Scoping Activities	6/15/02
	•	Report Documenting the Activities Leading to the "Short List" of Alternatives	6/17/02
	•	Provide Final Report on all Activities including: ♦ Preferred Alternative(s) ♦ Recommended R&D ♦ Relative Cost Estimate	7/15/02

NOTE: Throughout this process the HLW Tank 48H Disposition Team provided periodic briefings and status updates to the HLW Management and DOE via routine meetings and reports.

Appendix 4 - R&D, Schedule and Cost

The two highest-ranking alternatives are the two processes that the team considers the most mature technologies – Salt Cell Technology/Processing and Steam Reforming. These are probably the two most expensive process alternatives as they are complicated and will require the construction of a new facility. Based on a 1999 estimate to move the salt cell to Building 512-S[7] – the expected cost to move salt cell operations would cost ~$40M and take ~24 months. The steam reforming is expected to cost a little more and take longer due to develop and demonstration of the process. There are other potentially viable processes but these have not been optimized nor has testing been completed at a variety of scales or with radioactive waste. As a result, additional research is required to help to improve the scientific understanding and identify and address some of the risks inherent in each of these processing alternatives.

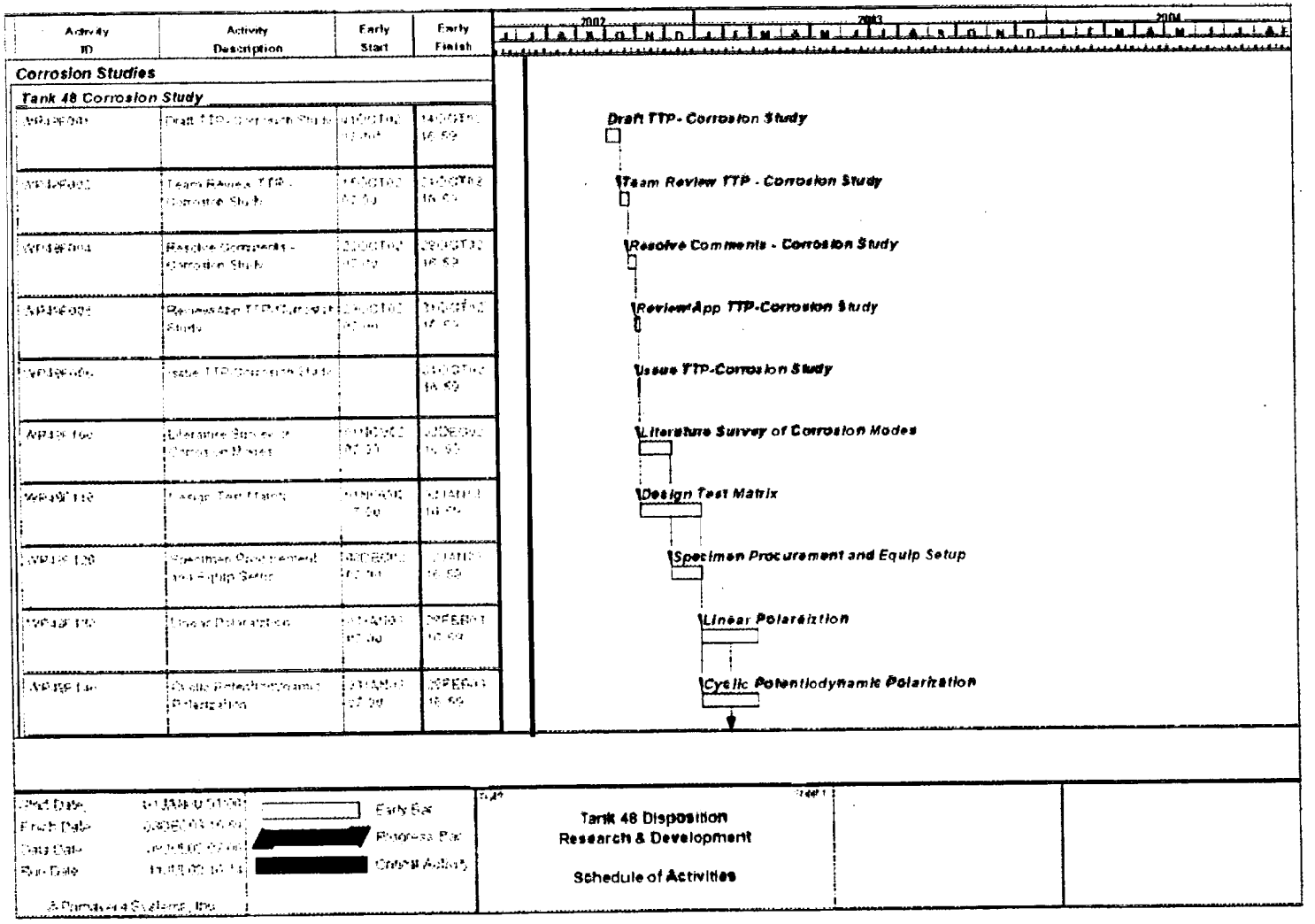
A preliminary schedule and budget estimate has been developed to complete the basic research that is required to allow the Tank 48H Team to recommended a process and a back up process for the destruction of the TPB in Tank 48H. The following are the main elements of research and development that are recommended:

1. Corrosion Study – If any of the alternatives is implemented in Tank 48H, an understanding of the chemistry changes is necessary prior to implementation. A corrosion study is necessary to determine the relative corrosion rates of the high-ranking in-tank alternatives. In addition, development of acceptable times, temperatures, and chemical concentrations for protecting the tank are necessary.
2. Stoichiometry study – In order to minimize the amount of reagents necessary for completing the reaction and to understand kinetics of the TPB decomposition, a study is required to optimize the process using simulants.
3. Carbon Balance study – One of the most important considerations in each of the processes is the identification of the TPB decomposition products for each of the processes. For example, a process that produces carbon dioxide would be preferable to a process that produces benzene. A process that produces fewer tar-like organic would be preferred. Analysis of the off-gas, the liquid and the solid deposits is necessary to identify the TPB decomposition products as this would be important in comparing the alternatives.
4. Tank 48H Characterization – Tank 48H will be sampled and the samples will be analyzed to understand the composition of this tank and develop a more complete simulant recipe. A thorough analysis of a well-mixed sample has not been completed since 1998. Since a radioactive tank's chemistry is constantly changing, a current analysis is needed.
5. Actual Waste Testing – Testing with actual waste is essential in demonstrating that the processing, developed using nonradioactive simulants, works with actual waste. HLW is an extremely complicated mixture of components. Not all of these components are in our simulants. As a result, real waste testing is necessary to ensure that one of these components does not impact the planned processing.

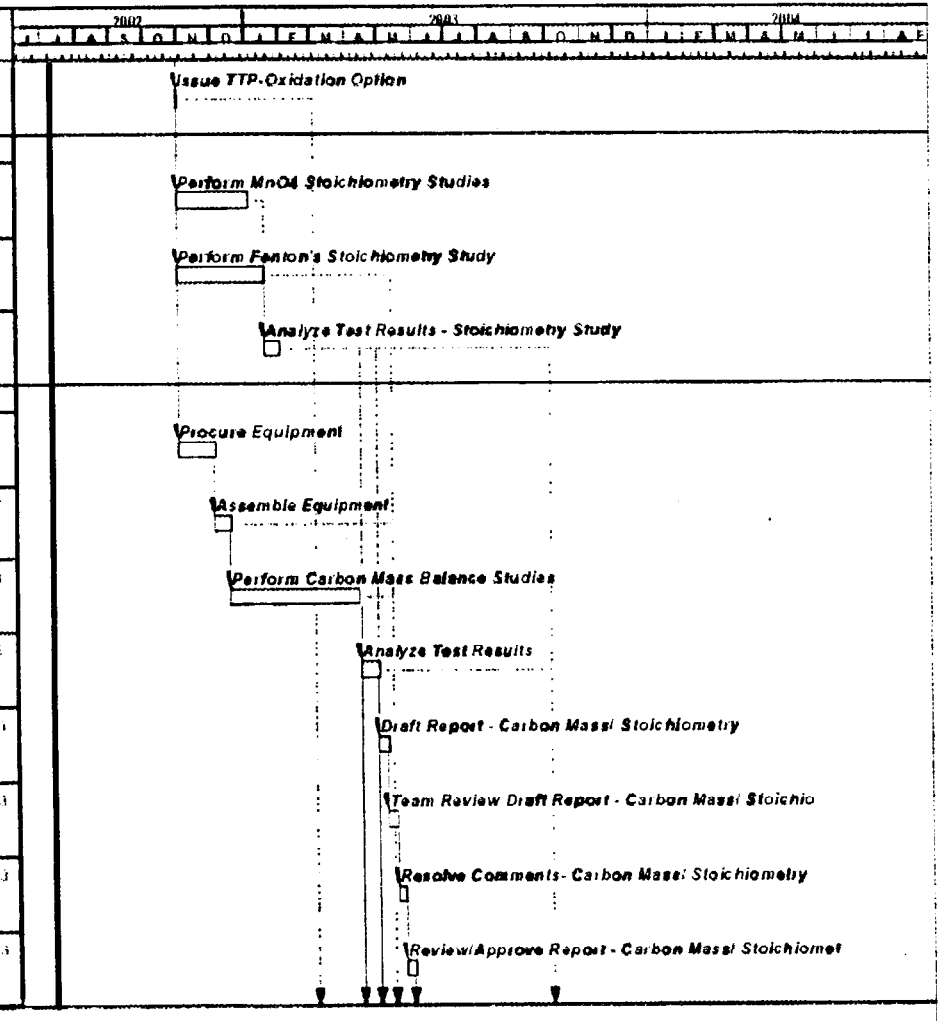
6. Demonstration at Scale – Scale-up is important in any process development. To minimize cost, early research is done at a very small scale. The testing completed to date has been at a volume of 100 ml. This is approximately 1:9,500,000 scale. If in-tank testing is desirable, it should be tested at the maximum scale practical. For example, a 250 gallon experiment would be 1:1,000 scale.
7. Steam Reforming Testing – Several steam reforming tests are recommended, including DTA/TGA studies to understand the TPB decomposition temperature and decomposition products under high temperature conditions. In addition, testing of calcined waste in Parr Bombs (vessels designed to handle high temperatures and pressures) is recommended to understand the composition of the solid product that will be produced via steam reforming. Larger scale and real waste testing of steam reforming may be performed by ORNL and PNNL because of existing equipment and processing experience.
8. Testing of downstream processing – The products of the processing will need further processing in existing SRS facilities. For example, the resulting salt solution will be processed in the Salt Disposition Facility creating a stream that will be processed via Saltstone and second stream that will be processed in DWPF. Testing will be necessary to ensure that the product of the Tank 48H process will be compatible with downstream processing facilities.

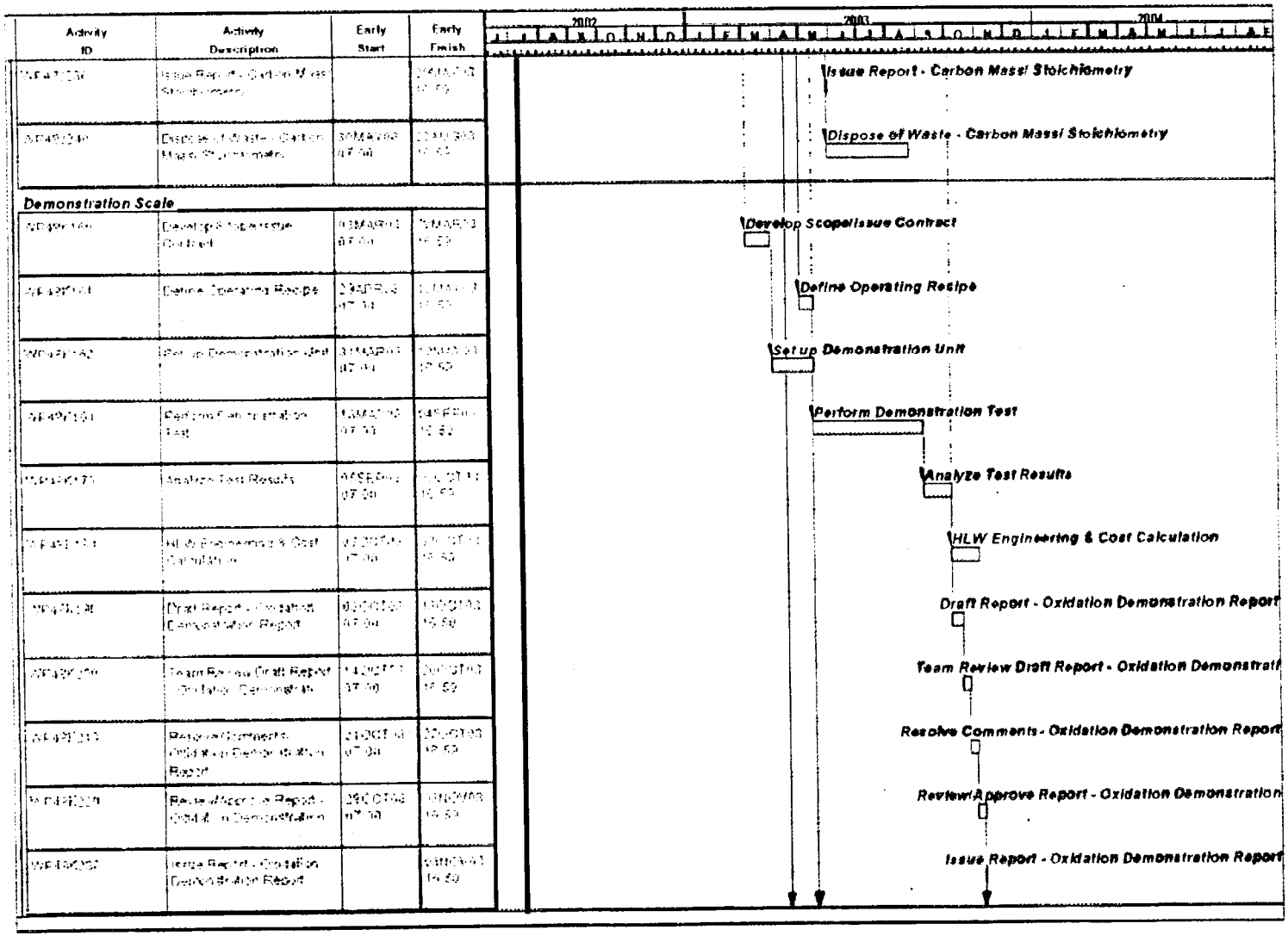
Cost Estimate for Research and Development

	Subcontract Cost	*TOTAL Cost*
Tank 48H Disposition Project	$887,700	$2,374,000
Corrosion Study		$220,000
Oxidation Options	$350,000	$760,000
Actual Waste Testing		$340,000
Bioremediation	$37,700	$90,000
Baseline Hydrolysis		$130,000
Tank 48H Characterization		$24,000
Steam Reforming	$500,000	$660,000
Downstream Facility Studies		$150,000

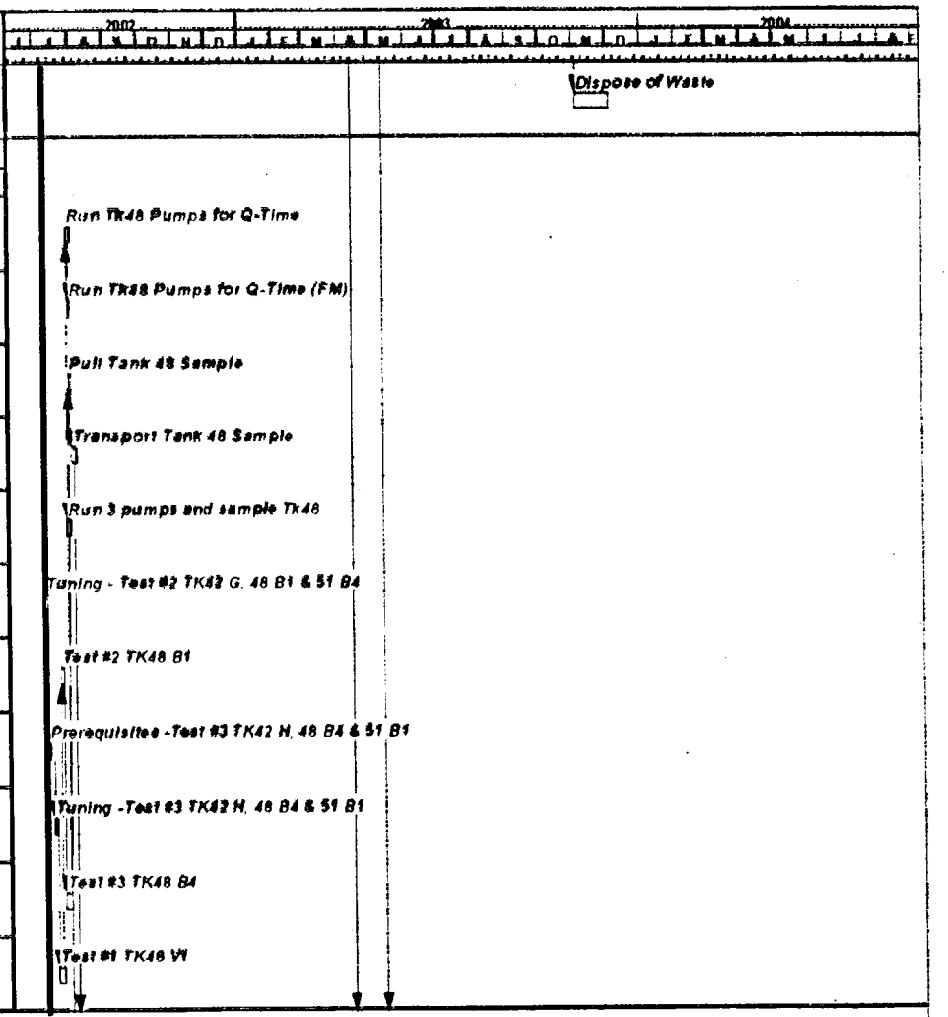

Activity ID
Activity Description
Early Start
Early Finish
2002
2003
2004
Corrosion Studies
Tank 48 Corrosion Study
Draft TTP- Corrosion Study
Team Review TTP - Corrosion Study
Resolve Comments - Corrosion Study
Review/App TTP-Corrosion Study
Issue TTP-Corrosion Study
Literature Survey of Corrosion Modes
Design Test Matrix
Specimen Procurement and Equip Setup
Linear Polarization
Cyclic Potentiodynamic Polarization
Early Bar
Progress Bar
Critical Activity
Tank 48 Disposition
Research & Development
Schedule of Activities

Activity ID	Activity Description	Early Start	Early Finish
WP48G150	Issue TTP-Oxidation Option		31OCT02 16:59
Stoichiometry Studies			
WP48H162	Perform MnO4 Stoichiometry Studies	01NOV02 07:00	02JAN03 16:59
WP48H164	Perform Fenton's Stoichiometry Study	01NOV02 07:00	16JAN03 16:59
WP48H170	Analyze Test Results Stoichiometry Study	17JAN03 07:00	24JAN03 16:59
Carbon Mass Balance			
WP48J160	Procure Equipment	01NOV02 07:00	12DEC02 16:59
WP48J162	Assemble Equipment	13DEC02 07:00	16DEC02 16:59
WP48J164	Perform Carbon Mass Balance Studies	17DEC02 07:00	11APR03 16:59
WP48J170	Analyze Test Results	14APR03 07:00	25APR03 16:59
WP48J180	Draft Report - Carbon Mass/ Stoichiometry	28APR03 07:00	07MAY03 16:59
WP48J200	Team Review Draft Report - Carbon Mass/ Stoichio	08MAY03 07:00	14MAY03 16:59
WP48J210	Resolve Comments - Carbon Mass/ Stoichiometry	15MAY03 07:00	21MAY03 16:59
WP48J220	Review/Approve Report - Carbon Mass/ Stoichiomet	22MAY03 07:00	29MAY03 16:59

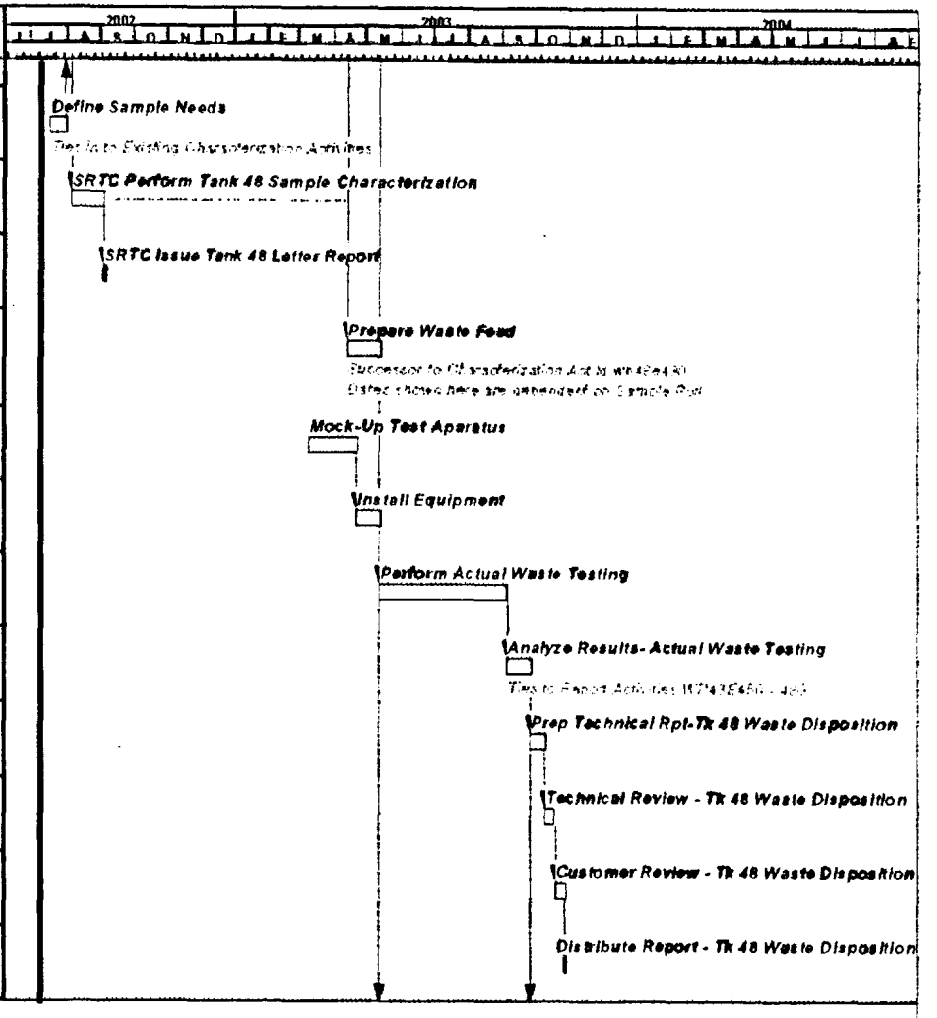


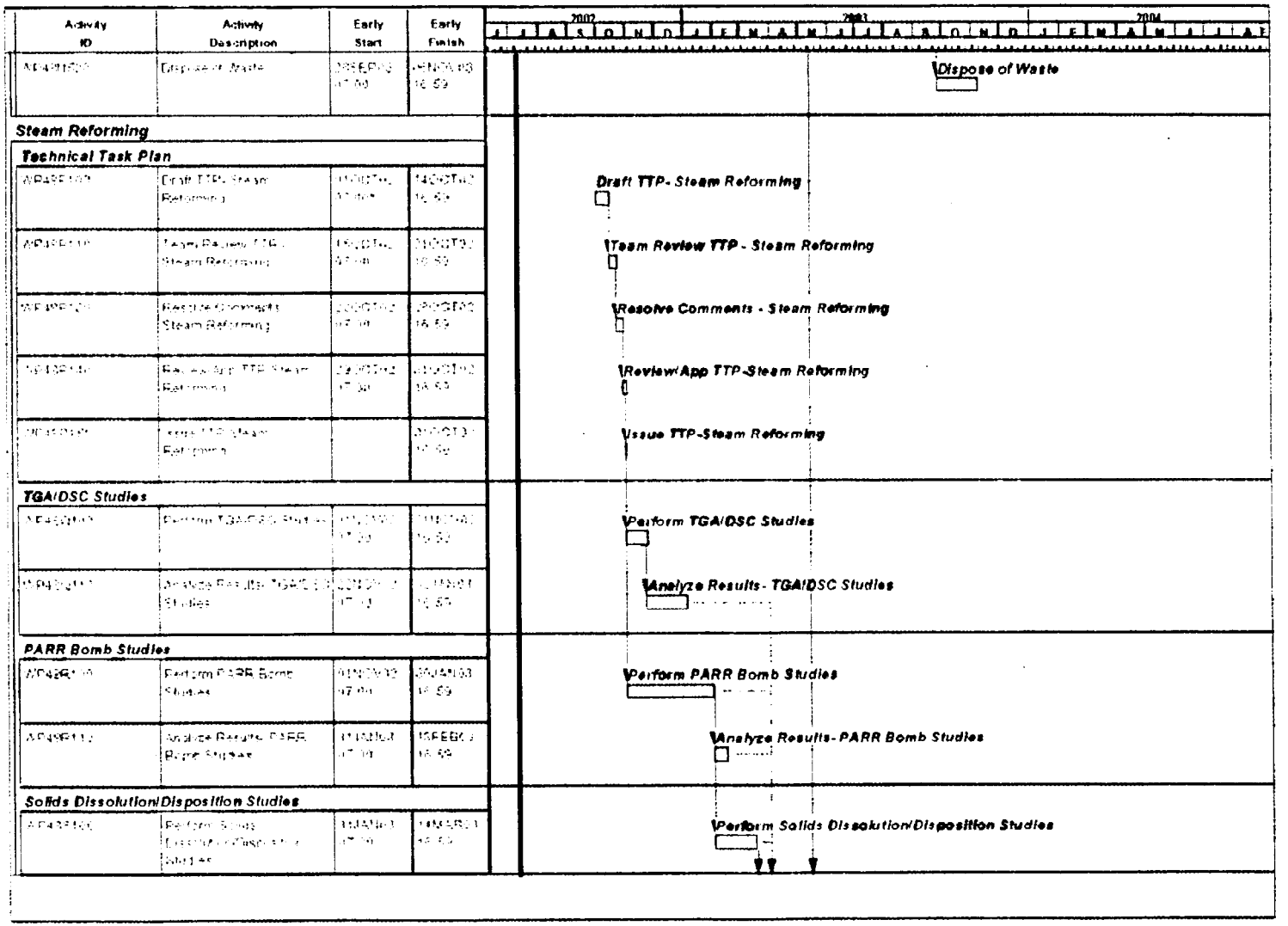

Activity ID
Activity Description
Early Start
Early Finish
2002
2003
2004
Issue Report - Carbon Mass Stoichiometry
Dispose of Waste - Carbon Mass Stoichiometry
Demonstration Scale
Develop Scope/Issue Contract
Define Operating Recipe
Set up Demonstration Unit
Perform Demonstration Test
Analyze Test Results
HLW Engineering & Cost Calculation
Draft Report - Oxidation Demonstration Report
Team Review Draft Report - Oxidation Demonstrati
Resolve Comments - Oxidation Demonstration Report
Review/Approve Report - Oxidation Demonstration
Issue Report - Oxidation Demonstration Report

Activity ID	Activity Description	Early Start	Early Finish
[illegible]	Dispose of Waste	[illegible]	[illegible]
Confirmatory Actual Waste Testing			
Tank 48 Real Waste Testing - OPS			
[illegible]	Run Tk48 Pumps for Q-Time	[illegible]	[illegible]
[illegible]	Run Tk48 Pumps for Q-Time (FM)		[illegible]
[illegible]	Pull Tank 48 Sample	[illegible]	[illegible]
[illegible]	Transport Tank 48 Sample	[illegible]	[illegible]
[illegible]	Run 3 pumps and sample Tk48	[illegible]	[illegible]
[illegible]	Tuning - Test #2 TK42 G, 48 B1 & 51 B4	[illegible]	[illegible]
[illegible]	Test #2 TK48 B1	[illegible]	[illegible]
[illegible]	Prerequisites - Test #3 TK42 H, 48 B4 & 51 B1	[illegible]	[illegible]
[illegible]	Tuning - Test #3 TK42 H, 48 B4 & 51 B1	[illegible]	[illegible]
[illegible]	Test #3 TK48 B4	[illegible]	[illegible]
[illegible]	Test #1 TK48 W1	[illegible]	[illegible]

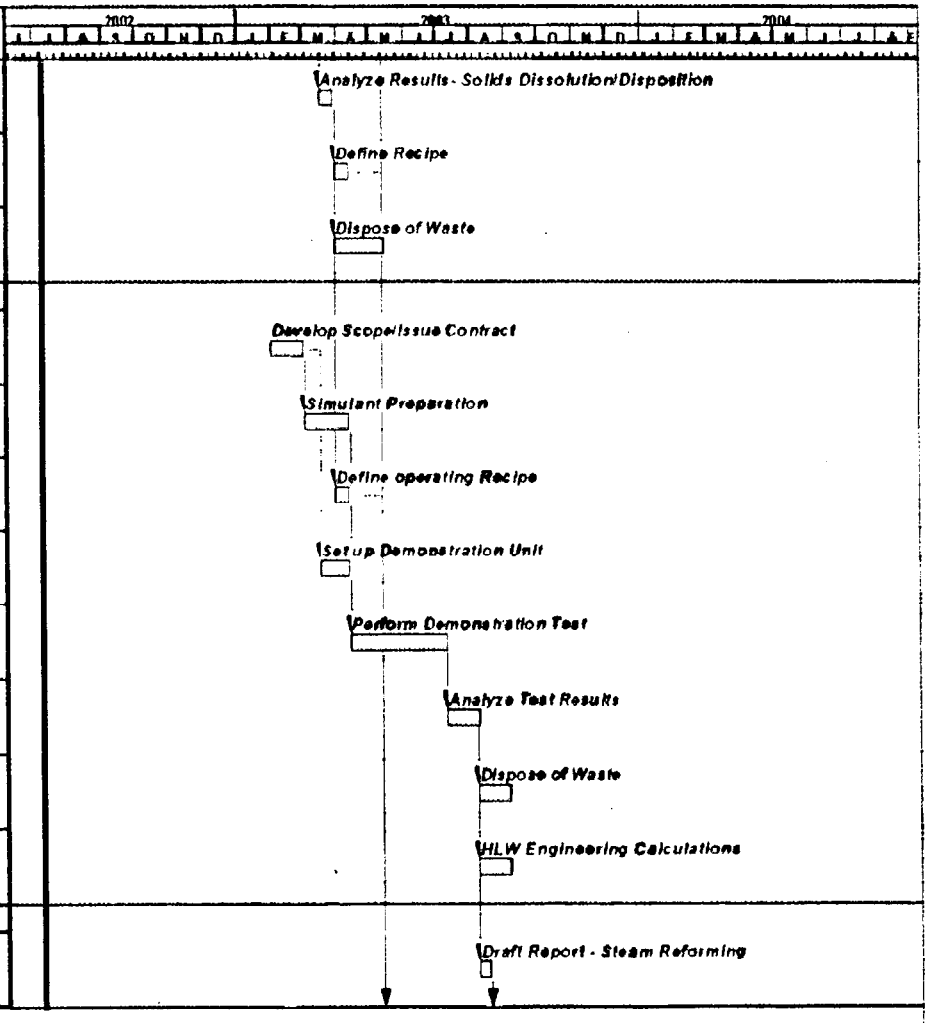


Activity ID	Activity Description	Early Start	Early Finish
Tank 48 Actual Waste Tests - R&D			
[illegible]	Define Sample Needs	[illegible]	[illegible]
[illegible]	SRTC Perform Tank 48 Sample Characterization	[illegible]	[illegible]
[illegible]	SRTC Issue Tank 48 Letter Report	[illegible]	[illegible]
[illegible]	Prepare Waste Feed	[illegible]	[illegible]
[illegible]	Mock-Up Test Apparatus	[illegible]	[illegible]
[illegible]	Install Equipment	[illegible]	[illegible]
[illegible]	Perform Actual Waste Testing	[illegible]	[illegible]
[illegible]	Analyze Results- Actual Waste Testing	[illegible]	[illegible]
[illegible]	Prep Technical Rpt-Tk 48 Waste Disposition	[illegible]	[illegible]
[illegible]	Technical Review - Tk 48 Waste Disposition	[illegible]	[illegible]
[illegible]	Customer Review - Tk 48 Waste Disposition	[illegible]	[illegible]
[illegible]	Distribute Report - Tk 48 Waste Disposition	[illegible]	[illegible]




Activity ID
Activity Description
Early Start
Early Finish
2002
2003
2004
Dispose of Waste
Steam Reforming
Technical Task Plan
Draft TTP- Steam Reforming
Team Review TTP - Steam Reforming
Resolve Comments - Steam Reforming
Review/App TTP-Steam Reforming
Issue TTP-Steam Reforming
TGA/DSC Studies
Perform TGA/DSC Studies
Analyze Results- TGA/DSC Studies
PARR Bomb Studies
Perform PARR Bomb Studies
Analyze Results- PARR Bomb Studies
Solids Dissolution/Disposition Studies
Perform Solids Dissolution/Disposition Studies

Activity ID	Activity Description	Early Start	Early Finish
[illegible]	Analyze Results - Solids Dissolution/Disposition	17MAR03 07:00	28MAR03 16:59
[illegible]	Define Recipe	31MAR03 07:00	11APR03 16:59
[illegible]	Dispose of Waste	31MAR03 07:00	12MAY03 16:59
Demonstration Scale			
[illegible]	Develop Scope/Issue Contract	11JAN03 07:00	05FEB03 16:59
[illegible]	Simulant Preparation	31MAR03 07:00	11APR03 16:59
[illegible]	Define operating Recipe	31MAR03 07:00	11APR03 16:59
[illegible]	Setup Demonstration Unit	17MAR03 07:00	11APR03 16:59
[illegible]	Perform Demonstration Test	14APR03 07:00	[illegible] 16:59
[illegible]	Analyze Test Results	12MAY03 07:00	[illegible] 16:59
[illegible]	Dispose of Waste	07AUG03 07:00	04SEP03 16:59
[illegible]	HLW Engineering Calculations	07AUG03 07:00	04SEP03 16:59
Summary Report			
[illegible]	Draft Report - Steam Reforming	07AUG03 07:00	15AUG03 16:59



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[illegible]	Resolve Comments - Steam Reforming	[illegible]	[illegible]
[illegible]	Review/Approve Report - Steam Reforming	[illegible]	[illegible]
[illegible]	Issue Report - Steam Reforming		[illegible]
Baseline Hydrolysis			
Baseline Hydrolysis			
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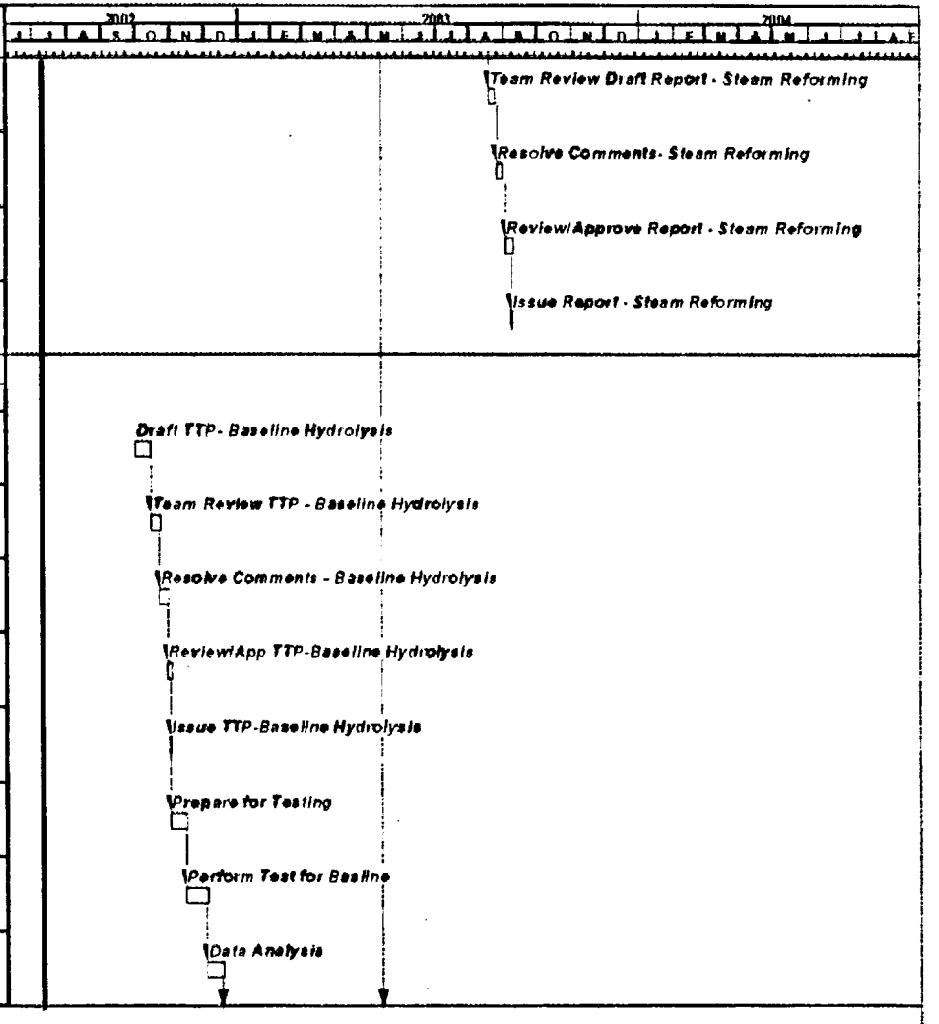
[illegible]	Resolve Comments - Baseline Hydrolysis	[illegible]	[illegible]
[illegible]	Review/App TTP - Baseline Hydrolysis	[illegible]	[illegible]
[illegible]	Issue TTP - Baseline Hydrolysis		[illegible]
[illegible]	Prepare for Testing	[illegible]	[illegible]
[illegible]	Perform Test for Baseline	[illegible]	[illegible]
[illegible]	Data Analysis	[illegible]	[illegible]



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[illegible]	Team Review Draft Report - Baseline Hydrolysis	[illegible]	[illegible]
[illegible]	Resolve Comments - Baseline Hydrolysis	[illegible]	[illegible]
[illegible]	Review/Approve Report - Baseline Hydrolysis	[illegible]	[illegible]
[illegible]	Issue Report - Baseline Hydrolysis		[illegible]
[illegible]	Dispose of Waste	[illegible]	[illegible]
Facility Studies			
Downstream Facility Studies			
[illegible]	Draft TTP - Downstream Facility Studies	[illegible]	[illegible]
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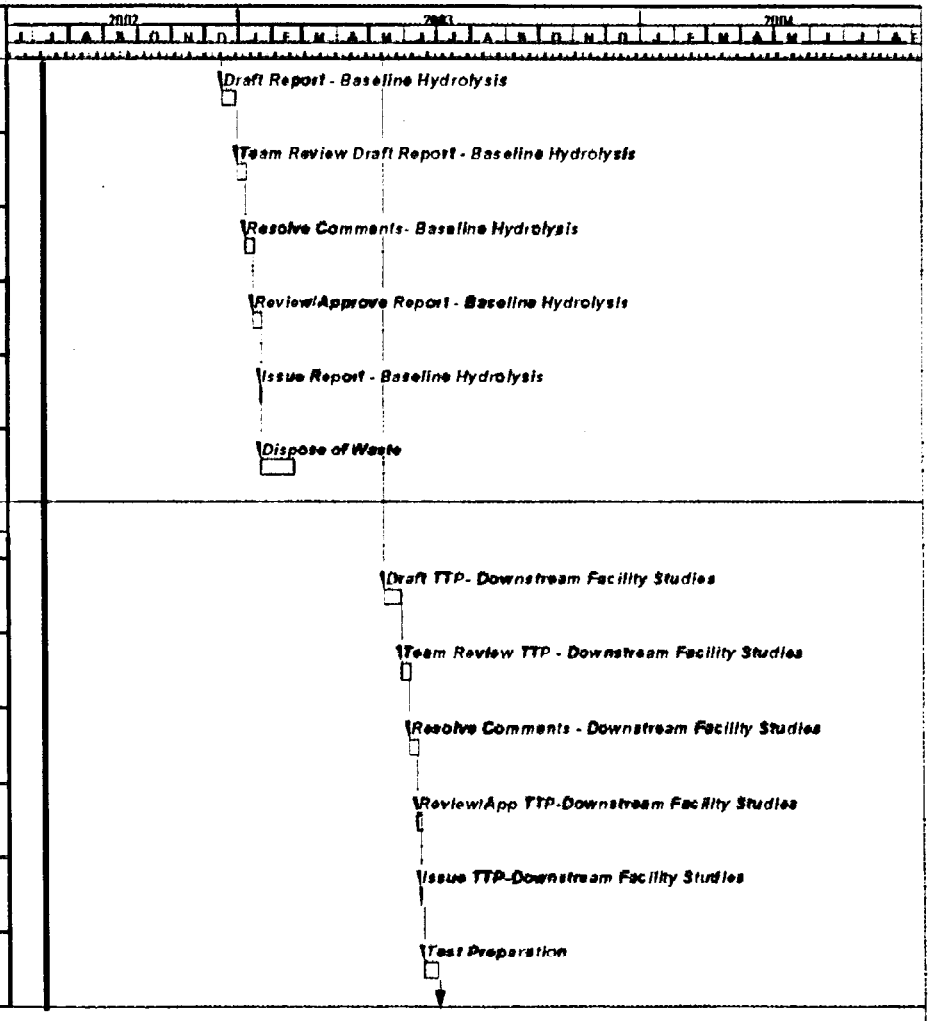
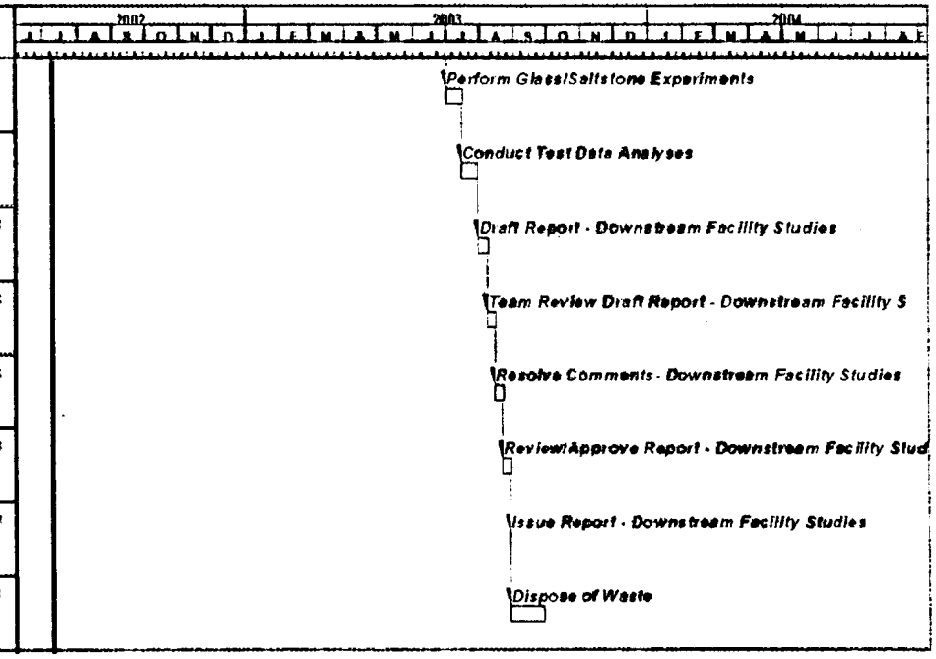
[illegible]	Test Preparation	[illegible]	[illegible]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[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
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