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Subject: David Bruce
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Date: July 19, 2011

To: Defense Nuclear Facilities Safety Board

From: David A. Bruce (Nuclear Chemical Process Engineer -- WTP Project)

Subject: Defense Nuclear Facilities Safety Board Recommendation Concerning the WTP Project Nuclear Safety & Quality Culture

First I would like to thank you for providing the first honest and true evaluation of the WTP Project Nuclear Safety & Quality Culture. I find your report to be accurate and correct in every aspect based on my personal experience working on the project as a process engineer starting in May of 2006. I received my first taste of the true WTP culture shortly after I was assigned to be the lead on the CNP evaporator. I identified the problem of process solution being forced up the liquid level and spgr bubbler dip tubes when the evaporator vacuum was released resulting in contamination inside the instrument piping located in a C3 area. When I went to the other engineer responsible for vacuum evaporators, he said, "Boy you better shut up or they'll fire you!" WTP engineers feel exactly the same retaliation pressures today. Shortly thereafter, the project was fined for retaliation and had to reinstate an engineer. There is never any change in the project Nuclear Safety & Quality Culture, there is only more rhetoric from top management, but everyone knows cost & schedule are still the main drivers. These drivers are manifested at the lower management levels as, "NO CHANGES".

The HSS review did not change anything because it was a sham from the start orchestrated from the top of DOE and top project management. No sooner had DOE announced the HSS review than WTP management hurriedly announced an internal safety review to take place prior to the HSS review. I was "randomly" picked for an interview, but knew it would be a waste of time and felt it was harassment and declined the opportunity to interview twice. Then the HSS team announced there would be a project "goon" to meet us at the interview building "to be sure those being interviewed made connection with the interviewers". This is clearly an act of intimidation and I filed a complaint with the local DOE Inspector General's office, but they did nothing. The HSS interview went well and I laid it on them for an hour, but nothing I said was good enough to report.

There is another driver that hinders Nuclear Safety and kills Nuclear Quality and that is blind adherence to the contract, better known as "contract minimum" or "design meets the contract, no more and no less." This policy has been a millstone around the competent engineer's neck throughout the project and is frequently used as an excuse for "NO CHANGES". This is driven down on the lower managers from above. My current manager is the best engineering manager on the project and he would always do the right thing if he was not over-ridden from above.

One clear indication that a functioning Nuclear Safety & Quality Culture does not exist on the WTP Project is the ability of engineering management to completely ignore for months competent technical design analysis showing safety problems with the current design. Without the engineer keeping pressure on his management the problems would never be addressed. When I performed the hydraulic analysis of the vacuum evaporator dip tube problem the first three layers of management ignored me and the problem altogether. I had to go to the level above them to the head of PE&T to get any movement. He was temporarily on loan from PNNL and was not a member of the "NO CHANGES" club. Even so, he was not forceful in pursuing the necessary changes. When he left, his replacement made four levels of inert engineering management and thereafter I received no backing even on the evaporator reboiler steam condensate contamination problem. After months of pushing my management to change the design, both my management and Mechanical Systems Management said, "If you are not satisfied, you need to write a PIER", which I did. Over the next few months, I had to ride herd on them as they tried one shifty plan after the other to finesse the issue without changing the design. I was never notified of the meetings, but when I got wind of one, I would show up and challenge their fatally flawed design in front of DOE. It was during this time that over a period of a few months my management called me into the office to chew on me three different times because I was too out spoken and my emails had offended someone. I looked upon this behavior as harassment because I would not relent and would accept nothing other than a costly design change. Finally the head of Bechtel's Nuclear Safety from headquarters spent a week in Richland and conducted a several day Kempner-Trego analysis of the reboiler steam condensate system. The WTP radiation monitor/diversion design failed in the first 30 minutes and the closed loop design was adopted, which is a standard nuclear facility design and is one of the two designs I had recommended a year earlier. Now, tell me where a strong Nuclear Safety & Quality Culture shows up anyplace in this. It's as dead as dead can be.

The Deputy Engineering Group Manager who had steadfastly pushed the fatally flawed design which used a radiation monitor quietly left the project and took a job at another Bechtel project. He kept glibly saying such a system was in use at SRNL, which was not true.

I could go on and on citing examples that indicate a robust Nuclear Safety & Quality Culture does not exist on the WTP Project. One of the most disheartening things is that these young engineers have to try to function under the clear and ever present danger of retaliation if they try to do what is ethically correct. Retaliation is not only immoral it is illegal yet over the years, DOE, has done nothing to correct the behavior and even appears to be complicit in the drive of cost and schedule.

The very best and smartest Process Engineer left the project to take another job because he knew the project management would get rid of him at the first chance. He had been on the project many years, he is a world class ion exchange expert, and was instrumental in developing the RF resin. During his tenure on the project he had locked horns with management many times because he was technically correct and management was not. There is only one reason he left, the ever present reality of retaliation for not falling in line with cost and schedule. Sure enough, about two months after he left the project, his boss, Dr. Tomasitis was brutally fired. Does this even remotely sound like there is a functioning Nuclear Safety & Quality Culture at WTP?

I can recognize a functioning Nuclear Safety & Quality Culture when I see one. I have been a Nuclear Chemical Process Engineer here at Hanford for 46 years and my experience history is included in the attachments.

I am enclosing some attachments that are pertinent to the discussion. I have covered only part of the iceberg here. There is much more information and I am looking forward to helping out any way I can. I want you to know you are on the right track and you have my full support. I will do anything you need me to do including testify under oath and point you to documentation that will help your cause, which is just. Be of good cheer and fight the good fight, win, lose or draw.

Sincerely,

David A. Bruce

I handed this to the HSS interviewers and showed them documentation also.

HHS Team Review of WTP August 2010   DA Bruce 8-29-2010

Topics & Comments:

First off, this is not an indictment of any one person on the project. I have enjoyed working with a great number of people. We do not always agree because of differences in priority, experience, and understanding, but we keep trying to get the job done despite our differences.

This should be taken as a serious indictment of the WTP project culture, which has always placed cost, schedule, and minimum contract compliance ahead of Nuclear Quality and Safety. Despite all of the great sounding pronouncements to the contrary, the "No Design Changes" attitude is firmly imbedded in the WTP culture at management's constant insistence. The "No Design Changes" attitude is kept alive and well because it is the minimum cost and shortest schedule path regardless if the plant is operable or not. I do not believe anyone on the project would knowingly design in a safety hazard, but with the main project direction not really focused on Nuclear Quality and Safety, it would be easy to miss a safety problem built into the design.

Another facet of the WTP culture that is extremely detrimental to the design of a safe, quality, and operable plant is the maltreatment of professional engineers who in good faith point out poor designs that are not safe and/or will not function. Instead of being rewarded for outstanding performance, they are persecuted because management does not want any design changes. At first management (at all levels) just does not acknowledge the problem or the engineer presenting the problem and this can go on for years. If the engineer is persistent management will try to down play the issue and try to look at trivial associated issues without acknowledging the real problem. Continued persistence on the engineer's part is risking poor performance appraisals, at the least, and possible termination of employment . There is a common understanding among the staff that taking a position contrary the management's "No Design Change" position will lead to being terminated in the next ROF cycle if not sooner.

Other than what is stated above this is a good job with lots of challenging technical problems to be solved.

Topics for discussion backed up by documentation:

1. **Lack of a functioning Nuclear Quality and Safety culture.**
    - There are several experienced engineers that truly know and understand the facets of a Nuclear Quality and Safety culture. However, management has not demonstrated any understanding of even the most basic principles. Their lack of understanding of simple radiation protection problems, whether by ignorance or design, tells the true story. They say that a questioning attitude is encouraged, but what they do not say is the answer is always no.
    - One example is the fatally flawed reboiler steam condensate recycle design that was brought up several times over a period of several years and every time management forced a continuation of the same fatally flawed design. I tried for four months to work

with my engineering management, (at all levels, including the Bechtel head engineering manager from headquarters) to resolve the issue correctly to no avail. During that time, I received no encouragement nor help in moving to the correct design. Both Mechanical systems management and my manager suggested that I write a PIER complaint, which I did. **(If engineering management cannot recognize a real radiological safety problem over a four month period, then it is obvious that there is no Nuclear Quality and Safety culture in existence.)**

- The vacuum evaporator dip tube and instrument line problem was met with the same resistance with only partial correction of the problem and with only minimal help from engineering management.

2. **Management retaliation/reprisal.**
   - When I first identified the vacuum evaporator dip tube/instrument line suck back problem in 2007, I went to another engineer to advise him some major design changes would be required. The first words out of his mouth were, "Boy, you better shut up or they will fire you!".
   - When Walt Tamosaitis was fired, the morning the news hit the newspaper, I received a call from another Bechtel office with some advice from a friend and he said, "Dave, you better watch yourself!".
   - Three times my management called me in the office to chew me out for not being polite in my emails to the design group that would not respond to make design changes. I took this as an attempt to muzzle dissent.
   - At appraisal time my URS manager gave me a very good appraisal while my Bechtel manager gave me a poor appraisal without any mention of the good engineering done in discovering design problems and solutions to those problems.
   - Throughout the > year-long battle to correct the fatally flawed reboiler steam condensate recycle design I noticed a great deal of reluctance of other engineers, including safety engineers, to get involved due to the fear of management reprisal.
3. **Management over-riding the technically correct design without any technical reason to do so.**
   - The several year-long reboiler steam condensate recycle saga is full of management demonstration of poor technical judgment.
   - More recently, the best option for the ion exchange feed solids mitigation was not chosen by WTP management.
4. **Discussions held with upper management**

Nuclear Chemical Processing Plant, Design, Startup & Operation Experience

The following lists the pertinent experience of D. A. Bruce by Hanford plant, giving process description, position held, and responsibilities:

43 years Nuclear Chemical Processing experience to date.

244-AR Vault (Small canyon building)--- This facility located adjacent to the "A" Tank Farm received supernate solutions and sludge sluiced out of the "A" Tank Farm tanks. The solutions were transferred to B-Plant for cesium recovery and purification. The sludge was dissolved in nitric acid in a 5,000 gallon tank in the AR-Vault prior to sending to B-Plant for strontium recovery and purification.

Position: Process Control Engineer -- Responsible for cold runs and hot startup.

- Wrote cold run procedures and conducted cold runs.
- Solved problem where waste receiver tanks could not be sampled above a certain liquid level.
- Wrote hot startup procedures and performed hot startup and initial hot operation.

B-Plant (Large canyon building)--- This plant was stripped of the equipment used with the original bismuth phosphate precipitation process, "decontaminated" and new equipment was installed to carry out the Waste Fractionization mission. The plant recovered cesium by ion exchange and strontium by solvent extraction, then purified both and stored the pure products.

Position: Process Control Engineer -- Responsible for cold runs and hot startup.

- Wrote cold test procedures for the Cell 23 Low Level Waste Concentrator and conducted cold test runs. Wrote hot operation procedures and started the concentrator up one year ahead of schedule to recover storage space in the underground waste tank farm. Waste was pumped from one waste tank to the concentrator, the waste was concentrated at a rate of 30 gpm boil-off and returned to an empty waste tank. The waste volume was reduced by more than one million gallons before the rest of B-Plant was started up.
- Wrote cold test procedures for the cesium ion exchange process where the cesium was loaded on a zeolite bed, eluted with ammonium carbonate/ammonium hydroxide solution, and concentrated in an evaporator for storage. The process included eluent recovery.
- Solved foaming problem in the evaporator that reduced the boil-off rate and caused cesium to be carried over into the recovered eluent.
- Wrote hot startup procedures and performed hot startup and initial hot operation.
- Solved problem where ammonia bearing waste passing through the AR-Vault reacted with the nitric acid vapor from the sludge dissolution process and plugged the vessel vent HEPA filters.

New 702A Ventilation System (Ventilation fan & HEPA filter building) -- This system provided increased ventilation capacity for the self-boiling underground high level waste tanks in the "A" Tank Farm. The system included two large exhaust fans, de-entrainer and HEPA filters.

Position: B-Plant Process Control Engineer (Loaned to the Tank Farm organization because they had no engineering staff of their own)

- After construction was complete, inspected the facility and found several design deficiencies that needed to be corrected prior to startup. Worked with project engineer and construction personnel to arrive at the specific changes to be made.
- One month later after changes were completed, wrote procedure to switch the self boiling waste tanks vent from the old fan to the new fan system.
- Found the new fans had too great a capacity and were being "starved", which caused unstable operation. Returned the system to the old vent fan.
- Designed a fan by-pass to return a portion of the fan exhaust to the fan inlet to bring the fan throughput to a level where the fan operated smoothly. Performed calculations to show the recycle would raise the fan discharge temperature only a few degrees. When the tank was opened to take pictures, the bypass was closed to take advantage of the full fan capacity.

<u>Waste Encapsulation & Storage Facility</u> (Seven mechanical manipulator operated hot cells with canyon above cells & water filled storage pool for Cs & Sr capsules)--- This facility was constructed on the West end of B-Plant and its mission was to take the strontium nitrate and cesium nitrate solutions stored in B-Plant, convert them to solid form and encapsulate the materials in welded containers with a welded outer over-pack container. The facility consisted of seven mechanical manipulator operated hot cells with 35" thick leaded glass shielding windows. The hot cells were located under cover blocks that were removed into the canyon above the cells by the canyon crane. Each cell also had a small cell hoist. There was also a pool cell on the West end of the building, which had 10 storage pools and a transfer pool for handling and storing the completed waste containers (capsules) under water.

Position: Manufacturing Engineer -- Operations representative responsible for facility design, construction, cold testing, hot startup, and hot operation.

- Gathered as much data as possible about hot cell operating experience for input into the preliminary design. Visited hot cells in the 300 Area, Oak Ridge, Savannah River Plant, Vallecitos Nuclear Center, and Lawarence Livermore Laboratory.
- Wrote trip report including all of the hot cell experience from many, many hot cell buildings giving detailed design information about the good, the bad , the ugly, and ridiculous designs encountered.
- Worked with AE designers during plant design to incorporate all of the good design features contained in the trip report.
- Worked in full size hot cell mockups to verify every wall nozzle location could be reached and to verify all equipment could be removed, replaced and maintained using the mechanical manipulators.
- During construction --- Worked with project engineers to solve problems as they became evident, to arrive at solutions that were satisfactory to operations and did not impact construction.
- After construction completion, was operations overseer for all of the cold testing. Wrote the building ventilation system operating procedures and conducted testing to verify correct control and operation.

- Worked with operations and engineering to solve both cold testing problems and hot startup problems.

Position: Process Engineering Supervisor -- Responsible for continued problem solving and equipment design improvement during hot operation.

- Conceived closed loop cooling system for all hot cells after experiencing a two month operations delay caused by the need to decontaminate the cooling water discharge header from B Cell after an in cell jumper was removed for maintenance.
- Directed design and pump procurement for closed loop cooling water system, which was successful and operated without failure throughout the life of the plant.

<u>PUREX Plant (Large canyon building)</u>--- The plutonium uranium extraction plant started the processing of nuclear fuel in the mid 50s for the recovery of both plutonium and uranium. Unit operations included nuclear fuel de-cladding, fuel dissolution in nitric acid, solvent extraction for plutonium and uranium product extraction and purification, product concentration, waste de-nitration and concentration, and nitric acid recovery. The plant was shut down in 1972 and was restarted in 1983. Prior to restart, there was a new project that installed a plutonium oxide line in N cell where the plutonium nitrate PUREX product was precipitated as the oxalate, filtered on a drum filter, dropped into a calciner, converted to plutonium oxide and placed in food pack cans in a dry air glovebox.

Position: Principal Process Engineer -- Responsible for solving process problems as the plant was in preparation for restart of operations. Process Engineering representative on the N Cell plutonium oxide line project through design, construction, construction acceptance testing and cold testing. Assigned to provide an inhibited acid flush of the E-F6 high level waste concentrator because the reboilers were thought to be fouled due to a lower than normal boil-off rate. The concentrator concentrates the fission product waste off of the HA column and operates at 3M nitric acid. Heat transfer surface fouling at these conditions does not make sense. Ran the concentrator and got full boil-off rate by opening the steam condensate discharge valve. There was no fouling, the operator just did not know how to operate the concentrator.

- Toured the Plutonium Finishing Plant (PFP) and the Rocky Flats Plant to gather design data for input to the new N Cell plutonium oxide line design. PFP processed plutonium nitrate solutions from PUREX with the same glovebox operations as would be used in the new N Cell oxide line. Noted many improvements to the PFP design that could be incorporated into the N Cell design and worked with the AE engineers to get the best design possible for the N Cell oxide line.
- Provided innovative input to the project during the oxide line design and construction.
- Wrote 25% of the project construction acceptance tests (ATPs) and mentored young engineers in writing the other 75%.

WTP Project Differences of Priority & the Resulting Effect on Plant Design

One Sentence Summary:

The Pretreatment Plant will not start up per schedule nor will it perform to the base line throughput requirements until the remaining design deficiencies are identified and the necessary design changes are made.

Summary:

Project design decisions have been driven from the beginning of the project by cost and schedule rather than what is technically correct to provide the safest and most reliable facility for completion of the WTP mission.

There have been many design problems identified by the External Flowsheet Review Team (EFRT) reviews, the Technical Readiness Assessment (TRA) and WTP individual Engineers. Clearly, the whole project design is not on a technically sound basis as demonstrated by **every** technical review finding **significant** design problems. These design problems would not have been identified nor addressed without external review.

There is no objective evidence that the areas of the plant design that have not received a detailed review will be functional. There is in fact, a significant amount of objective evidence to the contrary.

Plant construction must continue or the plant will never be completed, however, clearly, there are many, yet to be identified, design problems to be solved and many of these will be built in as construction proceeds. The identification of the remaining design problems and their solutions, must be made as construction proceeds. Continuing construction as if there were no remaining design issues will lead to a failed plant start-up.

Discussion:

Project design decisions have been driven from the beginning of the project by cost and schedule rather than what is technically correct to provide the safest and most reliable facility for completion of the mission. Considerations of the Estimate At Completion (EAC) and the contract minimum design performance have kept a constant pressure on the design, which has been detrimental to producing a technically sound and operable plant design. This is clearly evident when the fatally flawed WTP process reboiler steam condensate recycle design history is traced from the early correct diagnosis of the fatal flaw, and identification of the correct design in September 2002. Through a seven year period, up until June 2009, project management continued to deny the existence of the problem until the design decision was taken out of their hands in June 2009. In June 2009, The Bechtel Nuclear Engineering Manager, Mike Durst, came to Richland from Fredrick Maryland to conduct meetings to solve the design problem. He had already determined the WTP design had not been used at SRNL as was being touted as the basis of the WTP design. The following is the documented history of the WTP fatally flawed WTP process reboiler steam condensate recycle design:

Date	Event/Documentation	Remarks
September, 2002	ISM III - Steam Condensate Return Lines (FEP, CNP, TEP & TLP Reboilers) --- CCN 038115 (Next meeting was to be held 10/22/02)	The ISM meeting minutes addressed the problem of reboiler tube failure and steam condensate contamination and correctly identified a secondary steam loop as one option for correction of the design. The 3rd bullet under "Path Forward" gives direction to, "Evaluate closed circuit condensate loop versus dedicated BOF supply and make recommendations." Assigned to Mechanical Utilities [Fred Farvis] and Process [Ed Strieper, Bob Hanson] (The "closed circuit condensate loop" is a proven nuclear industry standard design for process condensate recycle and would have solved the problem at that time if it had been adopted.)
10/22/02	None	The meeting scheduled for 10/22/02 was apparently never held or was not documented if it was held.
February 21, 2003	CCN 044723 ISM Cycle III Reconciliation for FEP	On page 2, it states, "The team determined that the radiation monitor in the process condensate stream **was not an effective barrier for the event under cousideration."**
June 9, 2003	WTP-BOF-10 Risk - Potential Contamination of BOF from LP condensate from FEP Reboiler CCN 058360	This meeting correctly identified contamination of the BOF steam plant and the heating steam to all four WTP facilities steam heating supplies. It also identified that the, "Current inline (radiation) detectors are not considered sensitive enough or quick enough to prevent contamination of BOF and beyond." This meeting developed six criteria for comparing alternate designs. The 6 criteria chosen were; Safety, Project Capitol Costs, Ops and Maintenance Costs, Project Schedule, Meet Project Mission, and Reliability/Redundant/Flexible. Seven options for comparison to the project design were identified and were evaluated using the criteria. Four of the seven were selected for further development. The four options and their criteria scores are given below with the highest score being the best: Option 2 - Secondary loop in pretreatment = 537 Option 4 - Single independent boiler for process steam - annex to PT = 530 Option 1 - Holdup Tanks = 507 Option 6 - High pressure steam side = 499 This meeting ended with action for the team members

		to develop additional information about the 4 options and meet again June 12, 2003.
June 12, 2003	CCN 058360 continued.	Option 2 - Secondary loop in pretreatment, was rejected because of high cost and it would not fit within the pretreatment building - **Even though it scored higher than the other options. Once again management could have made the right choice, but did not.** Option 6 was expensive and was too large to fit within the PT structure. Option 4 cost was $500K capitol and Option 1 was $485K. **Option 1 was chosen even though it ranked 3rd in the selection process.** The option to "Do Nothing" was evaluated and operating sampling costs would be $490K during the life of the plant, but would not prevent contamination of BOF nor recovery from contamination which would cost $15 million dollars (Less confidence than a ROM) Path Forward: 1. Present session results to management. 2. Redo Options 1 & 4 estimates. 3. Ready presentation to upper management 6/19/2003
July 15, 2003	CCN 063768 This is a transmittal of a Risk Assessment Report 24590-WTP-RPT-PR-01-006, Rev. 8	The risk assessment on page 8 identifies the potential for steam condensate contamination of BOF and refers to evaluations being conducted. It states the results of the evaluation will be included in the next Risk Assessment Report.
August 26, 2003	CCN 068442 "Revisit Control Strategy For FEP, CNP, and TLP Reboiler Tube Failure"	"2. The proposed alternative strategy determined by the team consists of an ITS/SDS gamma monitor interlocked to isolation/diversion valves located in the C3/R2 area adjacent to the black cell wall." "4. The team acknowledged that this strategy may allow contaminated condensate to bypass the monitor and interlock due to system response time delays (seconds). However the team did not consider this to be a significant risk to workers ...." "7. The TLP reboiler tube failure is currently designated an SL-3 event for the facility worker and therefore the only required ITS barrier is robust tube design (SDS)." **Note, the only concern here is for protection of the facility worker and there is no concern for recovery from the event or continuing operation of the plant.** "9. In summary, the control strategies to prevent/mitigate reboiler tube failure events for the FEP and CNP systems are as follows:

		• Robust design (QL-1) of the ITS/SDC reboiler tubes. • An ITS/SDS gamma monitor and interlocked isolation/diversion valves located out-cell in the C3/R2 area. • Shielding, as necessary, to ensure dose rates in the C3/R2 area remain within credible target levels. • Use of the alarm function with the gamma monitor to initiate evacuation of affected areas during the event." **Note, the only concern here is for protection of the facility worker and there is no concern for recovery from the event or continuing operation of the plant.**
September 3, 2003	24590-WTP-RPT-PO-03-019 WTP-BOF-10 Risk of contaminated condensate Returning to Steam Boilers-Quantification of Potential Health Risk	This report was apparently written to justify the "Do Nothing" option. The report makes statements that are false and has no technical pedigree. On page 5 it concludes, "This solution is feasible but only for short term operation intended to identify the source of the contamination and provide a pathway for decontamination activities. Long term operation under this configuration is not possible."
April 7, 2004	Risk Assessment Report 24590-WTP-RPT-PR-01-0006, Rev. 0	In the section "Closed Discovery Items", on page E-3, item 14 under the "Title" column it states: "Potential BOF Contamination by very low level radioactive leakage below detection limits, from pin hole corrosion of the FEP reboiler tubes into steam system may occur during operation phase. Build up over time would become detectable." Under the "Impacts" column it states, "The "Clean" designated BOF system, plant wide, may become contaminated due to spread through return steam. May also affect the NLD and TEDF systems. Plant operation may be impacted." Under the "Discovery/Trend Status" column, it states, "Determined not to be a risk to project. A white paper (24590-WTP-RPT-PO-03-019) was issued on Sept. 3, 2003. Design change proposed. **This is the same report noted above that concluded, "This solution is feasible but only for short term operation intended to identify the source of the contamination and provide a pathway for decontamination activities. Long term operation under this configuration is not possible."**

10-15-07	ECN 166110 "Establish CNP Steam Condensate Radiation Monitor/Interlock Specifications	It states, "This interlock is listed as an APC control in the PSAR, with the stated safety function to, "Provide defense in depth against reboiler tube leaks". More specifically, the interlock is intended to prevent contamination of the steam condensate system and, ultimately, the BOF steam generators in the event of a reboiler tube failure." The strategy proposed relies on closing the steam condensate valve down stream of the radiation monitor, "quickly", opening the diverter valve quickly and closing the steam supply valve quickly. **It is unlikely these valves can be safely actuated quickly due to water hammer considerations and this does nothing for recovery from a contamination event**
May 2008	Verbal communication and emails.	After identifying the proposed design was not a standard nuclear industry design for handling process reboiler steam condensate and would not keep the BOF steam plant from becoming contaminated, I called C&I to get information on the capability of the radiation monitor procured and found the instruments had not been procured. Held discussions with Nuclear Safety and Radiation Safety personnel. **At this point I determined WTP did not really have a design. I then communicated the problem to my management along with the solution.**
June & July 2008	Verbal communication and emails.	**Continued to point out to management, including Craig Myler, that the WTP process reboiler system was fatally flawed in that it would not prevent the contamination of the BOF steam plant and the design had to be changed to one of the nuclear industry standard designs; either once through steam use with no recycle or closed loop if recycle was used. The SRNL glass plant uses a closed loop, so why would WTP deviate from that design?**
August 2008	Verbal communication and emails.	**Continued discussions with management and started discussions with Mechanical Systems (MS). Found MS engineers were working to find a "sensitive" gamma monitor in a futile attempt to breath life into their dead horse design. Attended meetings with MS engineers and safety personnel.**
September 2008	Verbal communication and emails.	**Met with operations and they concurred that the steam condensate recycle system design was flawed and would not keep contamination out of BOF. The history they shared was that this problem had**

		been brought up before, but the Area Project Manager (APM) vetoed making the technically correct changes to the system. Continued discussions with MS engineers. MS management declined to make any changes in the steam condensate recycle design citing requirements had been met and procedures followed. They recommended that I write a PIER if I was not satisfied. I wrote a PIER and per my manager's direction, sent it to MS for any comments before issue.
October 2008	PIER 24590-WTP-PIER-MGT-08-1892	**Wrote PIER, which was issued October 13th.**
November 2008 through May 2009	Verbal communication and emails.	**During this 7 month period, Mechanical Systems remained in complete denial and continued put Band-Aids on their dead horse in the hopes it would resurrect. They also came up with other design options, but never gave up on their original fatally flawed design. Mechanical Systems did not involve me in any of the discussions concerning design options.**
June 2009	Verbal communication and emails.	**In June 2009, The Bechtel Nuclear Engineering Manager, Mike Durst, came to Richland from Fredrick Maryland to conduct meetings to solve the design problem. He had already determined the WTP design had not been used at SRNL as was being touted as the basis of the WTP design. Mike Durst engaged me and MS engineers to hammer out the "Musts" and "Wants" lists to be used in the evaluations of the design options presented by MS. Option 1 was the WTP gamma monitor design and it did not meet the "Must" criteria of having to prevent the BOF steam plant from becoming contaminated and this WTP design was rejected right off the bat.**

<u>Conclusion:</u>

The fatal design flaw (inability to prevent the BOF Steam Plant from becoming contaminated) was correctly identified and documented in September 2002. The correct fix for the design (closed loop condensate system) was identified and documented at the same time. Engineering management showed a complete lack of technical understanding of the problem and Project management would not commit to correcting the design, based only on cost and schedule. Engineering never did admit their design was flawed and the correct design was allowed only after the design decision was taken away from WTP engineering.

I got no response at all on this proposal!

Rich/Chris/John, 6-17-08

I believe PE&T now has the opportunity to significantly influence the project overall performance by requiring the Process System Lead Engineers and the backup engineers to perform an in depth review of their systems rather than just reviewing the P&IDs before sign-off as approved for construction. The WTP plant design is now mature enough to allow the engineers to gather the documented information necessary to perform a detailed process design review by integrating all facets of the design to verify that each process system is completely functional per the existing design. Areas where the current design falls short will be readily identified and corrective actions can be taken now where the changes can be made on paper as opposed to late identification of problems when the changes have to be made to concrete and steel.

As I have determined from taking a close look at operating the CNP system, several design features were found to be lacking that would not have been identified from only reviewing the P&IDs. I have listed six design problems, in the attachment, with the CNP and steam condensate systems, and two of the six are very major deficiencies that would have significantly delayed hot startup of the plant if not identified early while still in the design stage of the project. The two major items are the vacuum evaporator instrument air line suck-back/corrosion/plugging problems and the steam condensate system where steam condensate from the four process evaporator reboilers is reused as make up water in the steam plant. The steam condensate system design cannot keep contamination from reaching the steam plant where there is zero contamination allowed in the steam.

With several design problems identified in one process system, statistically it is only reasonable to take a closer look at the other major process systems. Failure of PE&T to do the in depth reviews would allow incomplete designs to be built into concrete and steel where the required changes will be extremely costly. There would be a very negative reflection on the project in general and PE&T in particular for having endorsed designs without adequate review. We have the successful outcome of this project within our grasp and we should not let this opportunity slip through our fingers.

The attachment discusses the elements necessary to perform a Detailed Process Design Review and the steps to be taken to perform such a detailed review. I have also attached my work experience that is pertinent to our current endeavor of design, construction, startup, and operation of a major Nuclear Chemical Processing Facility. I have spent the last 43 years working in and around the Hanford Nuclear Chemical Processing Plants as Process Engineer. The first 24 years were spent "in the front lines" in daily hand to hand combat with process, equipment, operations, and radiological problems in the operating plants. We all view things through the eyes of our experiences and I want you to be aware of from which I speak. I am not some crank trying to upset the apple cart, but rather I want to be a part of making the best apple cart possible. My extensive first hand experience with Nuclear Chemical Processing Facilities can be used to perfect all of the good basic design work that has already been accomplished.

Dave

Key Elements of a Successful Project

- Cost Under Budget
- Construction Complete Ahead of Schedule
- Rapid Startup Without Major Facility Modifications
- Hot Operation at Design Rates

PE&T Can Significantly Influence Project Overall Performance

- The design has progressed far enough to allow PE&T to coordinate all aspects of the current design for each specific process in order to verify each process can receive feed, perform the necessary chemical and physical operations and deliver acceptable feed to the next process.
- Radiological safety, process safety, process control, and operability would be key focus points during each process design evaluation.
- This work would be much more in depth and time consuming than the current design media review made prior to PE&T sign off.

PE&T Can Significantly Influence Project Overall Performance – Cont

- These detailed process design evaluations would verify the operability of the existing designs and provide early identification of areas where the designs need modification or additional features.
- Normally such detailed process design evaluation is not started until plant construction is complete and the construction acceptance testing is completed.
- Early identification of needed design changes will provide great cost savings to the project where the changes can be made to the drawings now instead of altering concrete and steel after the plant is constructed. The time from construction completion to Hot startup will also be greatly reduced.

Key Elements Included in Detailed Process Design Evaluations

- P&IDs – These drawings present the Starting Point for Each Process Design Evaluation
- Safety Basis – TSRs, OSRs, LCOs
- Radiation Safety – Contamination control & radiation shielding
- Hydrogen Mitigation
- Process Flowsheet – Material balance, temperatures, pressures, flow rates
- Sampling & Analysis Plan – Sampling Requirements

Key Elements -- continued

- System Description – General system information and operating modes. The System Description documents are currently out of date and Section 7 (Operations) would be updated as part of each Detailed Process Design Evaluation.
- Piping Design – Isometric drawings
- System Hydraulics
- Valve Location & Function – Valve type
- Maintenance

Key Elements -- continued

- Equipment Design – Detailed vendor drawings – Equipment performance capabilities
- Equipment Arrangement Drawings – Relative locations
- Process Control – Parameters to be controlled, ranges etc.
- Basic Scientific Data – Basis for process design and control
- Instrumentation – Capabilities, reliability, calibration & maintenance requirements.

Detailed Process Design Evaluation Process Steps

- Collect documentation for all of the "Key Elements"
- Use the particular process P&IDs as the starting point and road map for each detailed process design evaluation.
- Use the PFDs and Material Balance to determine the feed input to the process and product output to the next process
- Use the PFDs and Material Balance to determine the physical and chemical solution properties at each process step.

Detailed Process Design Evaluation Process Steps – Cont.

Write the step by step operating procedure outline to perform the necessary physical and chemical changes for each step of the process.

Evaluate the design:

- Are all of the design elements in place to accomplish the necessary physical and chemical changes?
- Perform a quantitative analysis of each piece of equipment as to its ability to meet the performance requirements for each step of the operating procedure.
- Needed design changes are readily identified when a procedure step cannot be accomplished, required radiological controls are not in place, or the necessary instrumentation to control the process is not in place per the current design.

Why Detailed Process Design Evaluation Is Needed Now

Any needed design changes that are identified now by the Detailed Process Design Evaluations will eventually be identified prior the hot startup as a normal course of a project. **They will not go away just because they are not identified before startup.**

As Process System Lead Engineer for the CNP Process, I have taken a close look at the current CNP system design and have identified the following **SIX** areas where design improvements are needed:

1. The design shows no provision for conductivity probe calibration or contamination control during probe removal and replacement in the recovered acid line. ***(A glovebox is needed to meet radiological contamination control requirements)***

2. There is a sampler in the 8,000 gallon recovered acid receiver vessel, which is needed, but there is no sampler in the recovered acid line, which is needed for real-time process control. ***(A real time recovered acid stream sampler is needed to accurately control the process to prevent solids precipitation in the evaporator)***

Why Detailed Process Design Evaluation Is Needed Now - Cont.

3. There are several design changes needed in the evaporator liquid level and spgr. Instrument lines and dip tubes to prevent corrosive failure of instrument lines and to keep instrument lines and dip tubes from plugging with solids. ***(These are MAJOR DESIGN FLAWS that are pertinent to all evaporators & will delay plant startup if not correctly addressed now!) (Instrument line failure in blackcell would occur below the evaporator solution level and would mean loss of the evaporator)***

4. The demister spray nozzles are not replaceable, the demister spray pattern will change as the nozzles wear and the manufacturer says they have a 10 year life. (per discussions with Gus Benz) The effectiveness of the demister sprays will be reduced over time which could lead to partial plugging of the de-entrainer, which would result in a lower Cs-137 DF due to the higher than design vapor velocity that would result from partial plugging the de-entrainer. ***(This design flaw is pertinent to all evaporators)***

5. The evaporator heel left after the evaporator bottoms have been transferred to HLP is 600 gallons, which is 29% of the evaporator operating capacity. The heel should be as small as possible and certainly not over 100 gallons. Otherwise, > 25% of the evaporator operating capacity will be lost. ***(This poor Quality design must be changed to leave a minimum heel in the evaporator)***

Why Detailed Process Design Evaluation Is Needed Now - Cont.

6. The current reboiler steam condensate design is deficient in that it does not ensure the BOF steam plant will not become contaminated after a reboiler leak of process solution into the steam condensate. The main flaw in the design is the reliance on steam condensate contamination detection using a radiation monitor. This is a failed design from the start for the following reasons: ***(This is a MAJOR DESIGN FLAW that threatens contamination of all four WTP plants and will not allow plant hot startup until it has been correctly addressed)***

- The allowable contamination level in the BOF Steam Plant is **ZERO CONTAMINATION.**

- All radiation detectors have a lower contamination detection limit, which is always above **ZERO CONTAMINATION.** This means that steam condensate contamination levels above **ZERO**, but below the lower detection limit, would routinely be routed to the steam plant, which is **NOT ALLOWED** by Radiation Protection Standards.

Why Detailed Process Design Evaluation Is Needed Now - Cont.

- The first two bullets kill the current design, but that is not the only design flaw. While the radiation monitor will divert contaminated condensate to the PWD system, the contaminated tanks, pumps and piping **CANNOT** be **DECONTAMINATED** to **FREE RELEASE STATUS**, which would be required prior to restoring the initial steam condensate route from the new reboiler to the BOF Steam Plant.
- Standard practice in Nuclear Chemical Processing Plants is to route steam condensate from process evaporator reboilers straight to disposal, without any attempt to recycle the steam condensate.

Bruce, David (WTP)

From: Bruce, David (WGI)
Sent: Sunday, November 25, 2007 8:11 PM
To: Brouns, Richard; Duncan, Garth M; Musick, Chris A; Olson, John W; Eager, Kevin
Cc: Bruce, David (WGI)
Subject: CNP Evaporator Liquid Level and Spgr Instrument Line Design Deficiencies

Attachments: CNP Evap Inst. Lines Case 1 11-24-07.vsd; CNP Evap Inst. Lines Case 2 11-24-07.vsd

Gentlemen,

The current CNP evaporator liquid level and spgr. instrument line design is seriously deficient in the following areas:

- The instrument lines were designed as if they would only contain instrument air, which is not the reality for vacuum evaporator service.
- There are four welds on these lines that have not been evaluated for corrosion against the 40 year design criteria. The welds in question connect the 1/2" sch 40 SST (0.109 wall thickness) instrument piping to the evaporator 1" sch 160 Hasteloy (0.25 wall thickness) evaporator dip tube piping. These welds will be wetted by the evaporator nitric acid solution every time there is an evaporator pressure fluctuation of as little as 14 mm Hg (7.8 in. water).
- When the evaporator vacuum is released and the pressure returned to atmospheric, evaporator liquid will rapidly inter the instrument lines and rise up to an elevation of about 18 feet above the evaporator liquid level.
- There is no line slope in the current design to return liquid back into the evaporator.
- The rapid surge of liquid into the instrument lines will carry any solids present in the evaporator liquid into the instrument lines.
- There are long horizontal pipe sections that will be filled with the liquid and solids out of the evaporator. Any solids present will settle out in the horizontal sections because the velocity of the solution returning into the evaporator is controlled by the instrument line air purge rate. At a normal air purge rate of 1.5 scfh, the solution velocity will be 0.2 of a foot per second. Repeated liquid surges into the instrument lines will certainly plug the horizontal sections with accumulated solids. (The CNP evaporator should not operate with solids, but there are similar instrument line designs for the FEP and TLP evaporators, which do have significant solids content, and all of the evaporators need to be evaluated)
- The rapid surge of solution up the instrument lines will carry contamination farther and farther up the instrument lines all the way up to and into the transmitters.

These are real live design problems and not some pipe dream theory. I first encountered the line plugging problem at the PUREX plant while performing cold runs on the newly installed Plutonium Oxide Facility in N Cell. We solved those problems in time for a successful hot start up and 5 years operation to plant shut down without any instrument line plugging problems.

The reality of operating instruments using dip tubes and bubblers in vessels under high vacuums is not well known or understood. The two attachments give a quantitative analysis of this behavior using the CNP evaporator current design. Case #1 describes the system with the evaporator in operation under vacuum. Case #2 describes the same system with the vacuum released and the evaporator at atmospheric pressure.

The weld problem is going to require more Hasteloy pipe for a satisfactory solution and we should move to get it ordered because if there is not some to be found in stock, it could be at least a year before more is manufactured.

There are several ways to mitigate the problems noted in the bullets above. I am ready to meet with you to answer any questions you may have.
I am making hard copies of this message and attachments for your convenience.

Dave

CNP Evap Inst. Lines Case 1 11...

CNP Evap Inst. Lines Case 2 11...

CASE #1 — CNP Evaporator operating at 80 mm Hg Pressure

1. Instrument line and liquid level dip tube filled with air and air bubbling into evaporator solution at 1.5 scfh.
2. Air pressure in instrument = liquid head from liquid column from liquid surface to end of dip tube + the pressure on the liquid surface. Solution height above end of dip tube = 63". For a solution of 1.10 spgr, the solution head = (1.1)(63) = 69.3 in. water pressure in the instrument line.
3. The volume of the instrument line can be found from the pipe dimensions. The instrument line is made up of 2 feet of 1" sch 160 Hasteloy pipe (0.25" wall thickness) and 118 feet of ½" sch 40 316L SST pipe (0.109" wall thickness). Total instrument line volume = 443 cubic inches.
4. Assume an average instrument air temperature of 90 F throughout the length of the instrument line.
5. The number of g-moles of air contained in the instrument line can be calculated using the Ideal Gas Law PV =nRT n = PV/RT

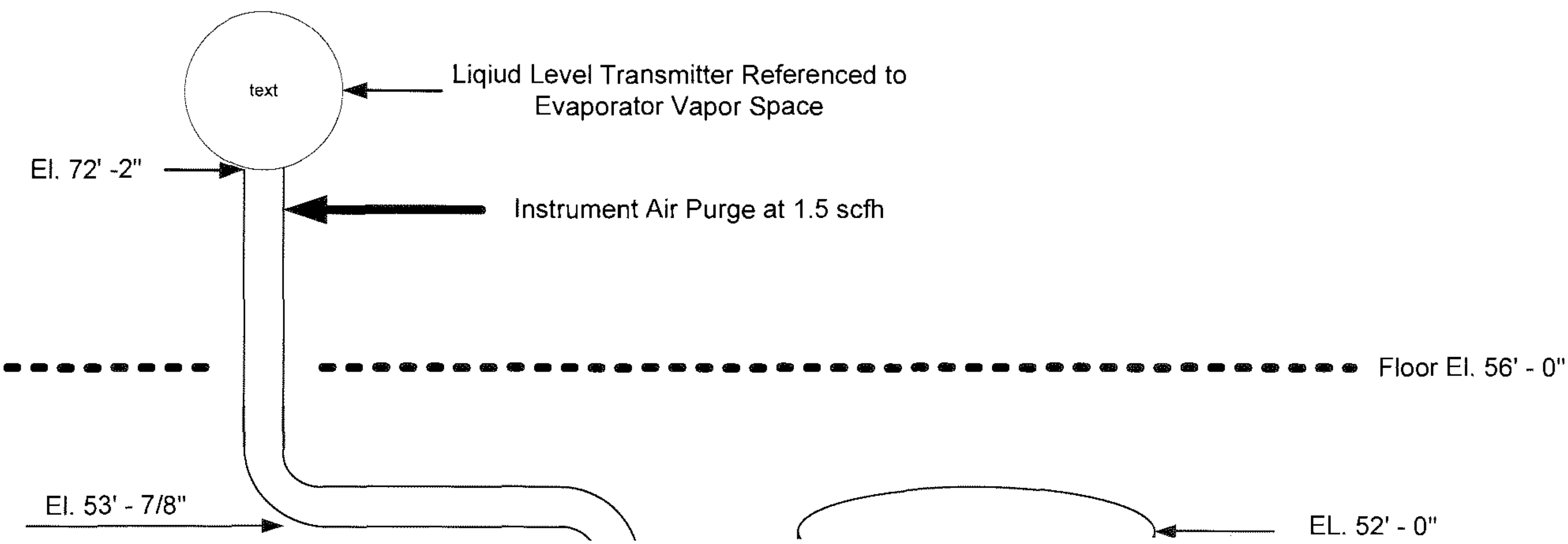
R = 62.3637 (Liters)(mmHg)/(g-mole)(degrees K)

Pressure P = (69.3 in. water)(1.868 mm Hg/in. water) + 80 mm Hg = 209.44 mm Hg

Volume V = (443 cubic inches)(0.01639 liters/cubic in.) = 7.26 liters

Temperature T = 90 F = 32.22 C 32.22 C + 273.15 = 305.37 K

n = PV/RT n = (209.44)(7.26)/(62.3637)(305.37) = 0.07985 g-moles of air contained in the instrument line when the evaporator is operating at a pressure of 80 mm Hg with a liquid spgr of 1.10. (Note that there will be no appreciable change in the number of g-moles of air in the instrument line when the vacuum is released and the evaporator is returned to atmospheric pressure. When this occurs, evaporator liquid is forced up into the instrument line so quickly that the 1.5 scfh air purge does not have time to add any appreciable quantity of air to the instrument line before the liquid has filled the instrument pipe to maximum level) The number of g-moles of air calculated in Case #1 is the same as the g-moles of air used in the Case #2 calculations.



CASE #2 — CNP Evaporator returned to atmospheric pressure for empty out --- Evaporator pressure = 760 mm Hg

1. Instrument line and liquid level dip tube has evaporator solution pushed up into line by pressure in evaporator.
2. Air pressure in instrument is unknown and will be calculated.
3. The volume of air in the instrument line is unknown and will be calculated to determine the height of the liquid in the instrument line above the evaporator liquid surface.
4. The transfer of liquid into and up the instrument line is very rapid once the evaporator vacuum is released. Therefore, the 1.5 scfh air purge will add a negligible amount of air during the event and the g-moles of air calculated in Case #1 can be used for the g-moles of air in the instrument line above the liquid in the line in Case #2. n= 0.07985 g-moles of air
4. Assume an average instrument air temperature of 90 F throughout the length of the instrument line.
5. The air pressure in the instrument line above the liquid in the line and the volume of the air can be calculated using the Ideal Gas Law PV = nRT The value of the right side of the equation is known: R = 62.3637 (Liters)(mmHg)/(g-mole)(degrees K)

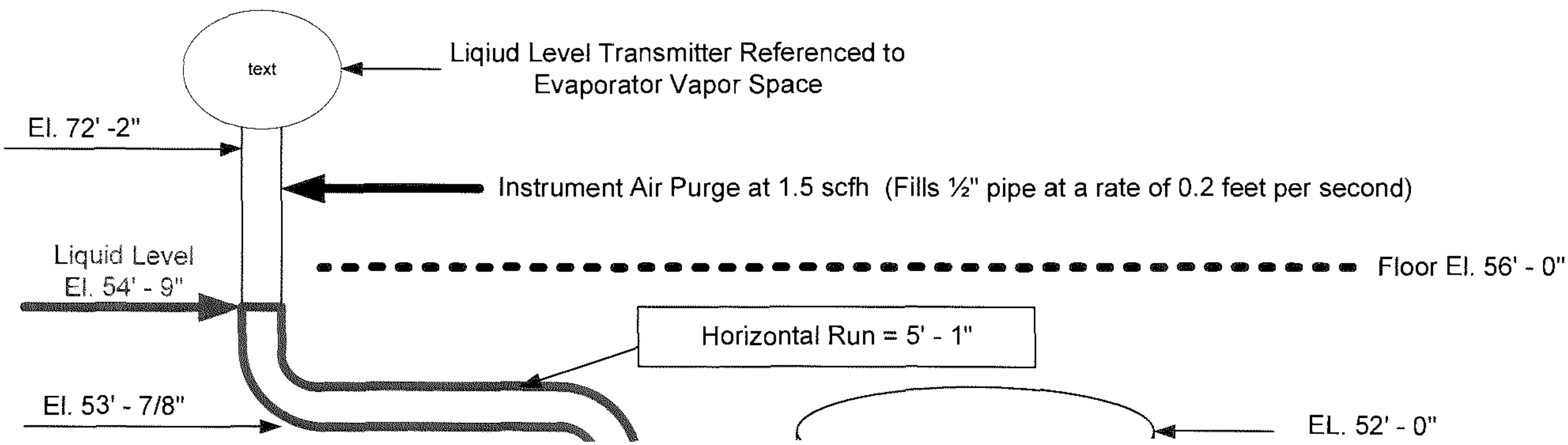
Temperature T = 90 F = 32.22 C 32.32 C + 273.15 = 305.37 K & n = 0.07985 g-moles

nRT = (0.07985)(62.3637)(305.37) = 1520.67 (mm Hg)(Liters)

The values of P & V are determined by iteration of the PV product where a height of liquid in the instrument line is assumed. Values of P & V are determined from the piping diagrams as follows: Because the weight of the liquid in the evaporator will fill up the instrument line up to the the level in the evaporator, the height "h" of solution in the instrument line above the evaporator liquid level = the iteration height value minus the evaporator liquid level elevation. Evaporator liquid level El. = 36' - 9".

The air pressure above the liquid level in the instrument line = 760 mm Hg - (Rho)(h) mm Hg.

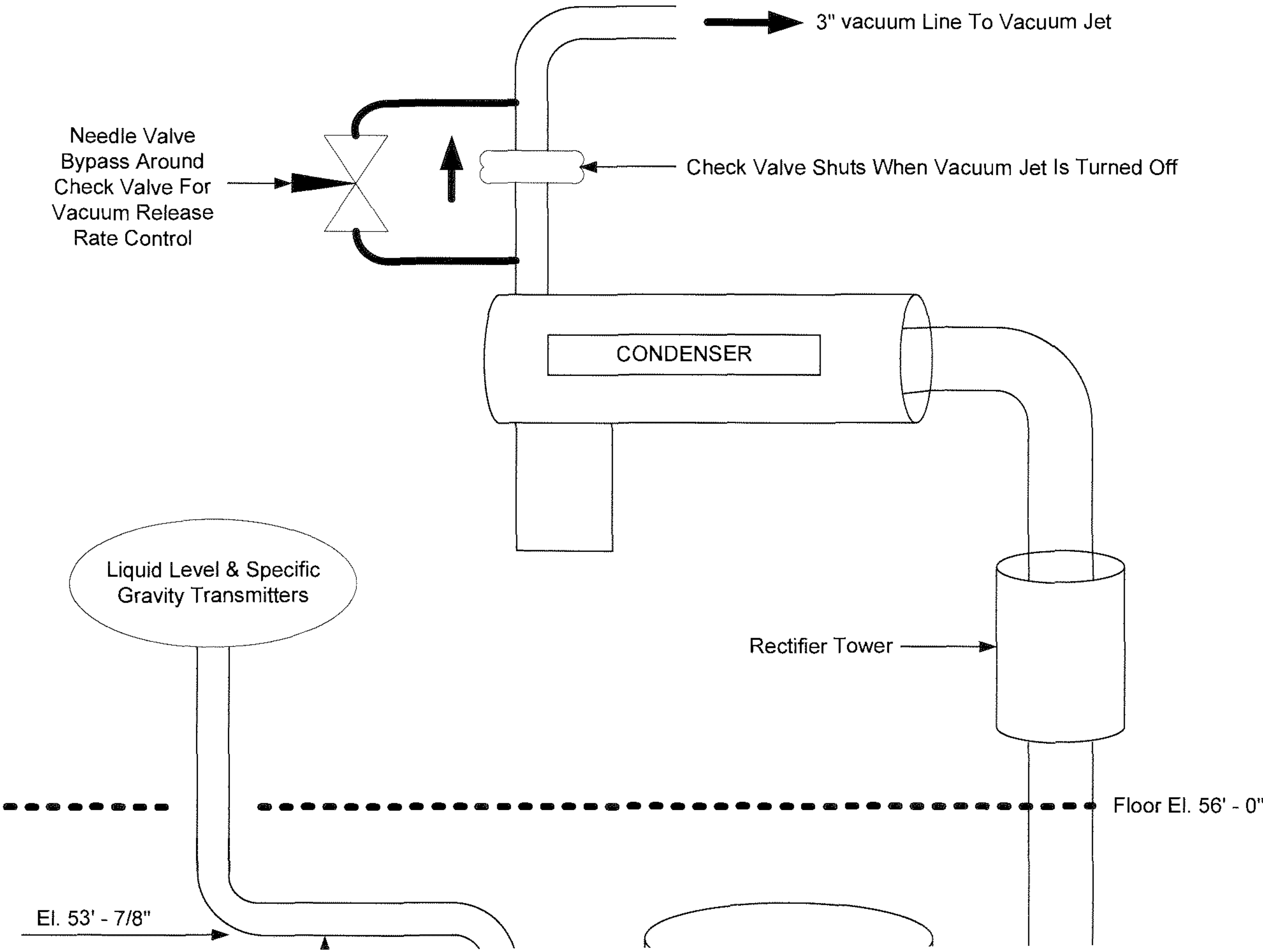
The air volume V is determined from the number of feet of piping that is above the chosen elevation on the piping drawings When this iterated product of PV = 1520.67 the problem is solved and the last elevation chosen is how high the solution will rise in the instrument line. (By iteration, the PV product is 1774 at a liquid elevation of 54' - 6" in the instrument line. The PV product is 1358 at a liquid elevation of 54' - 9" in the instrument line. The actual liquid elevation will be between 54' - 6" and 54' - 9", not allowing for the kinetic energy of the liquid surge. The liquid will rise up in the instrument line 18 feet above the evaporator liquid level to an elevation of approximately 54' - 9")



Design Change Option #1

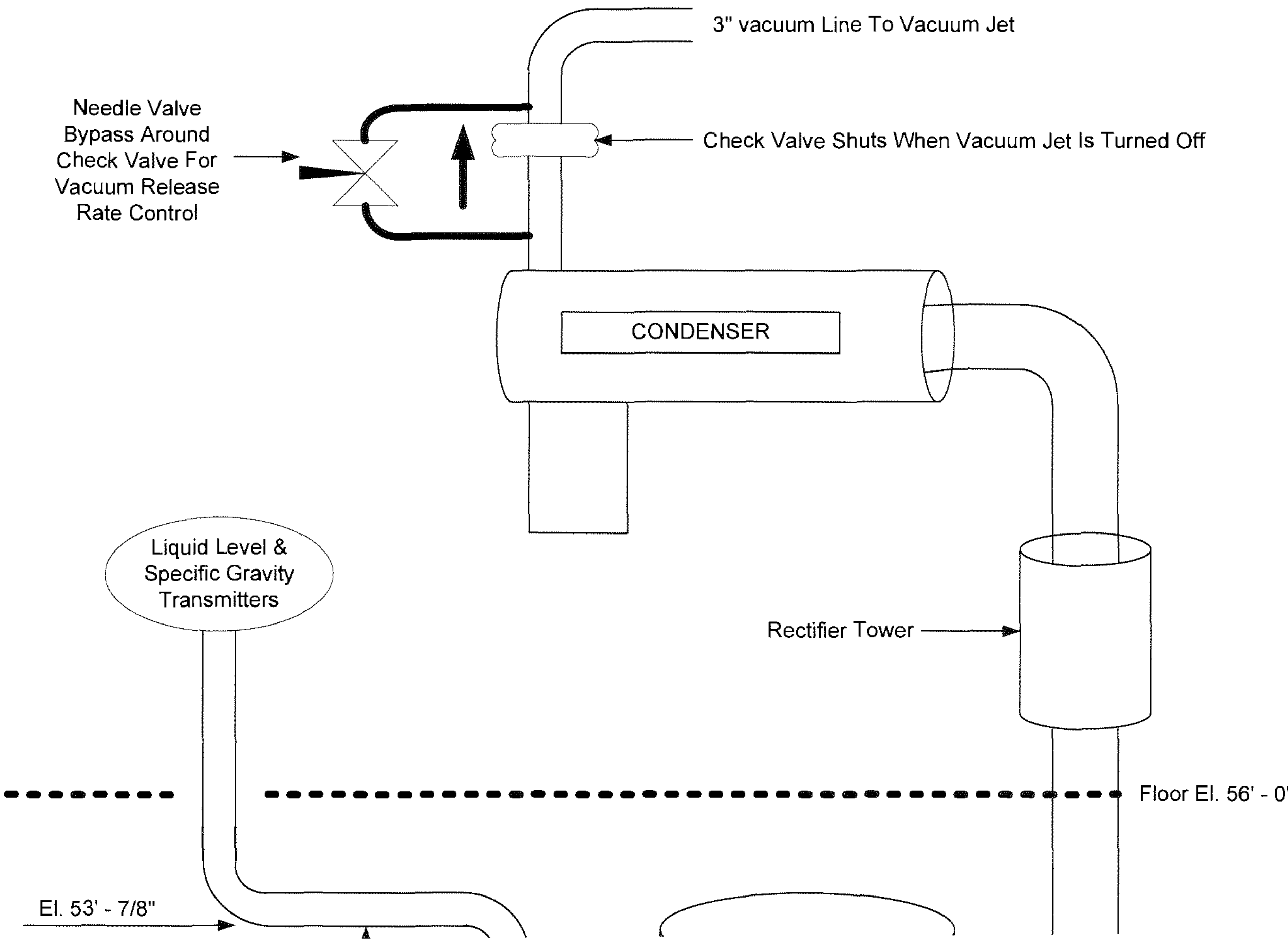
Evaporator instrument line vertical design to bring horizontal runs up above maximum solution level, instrument line pipe material same as dip tubes, and vent line check valve to control evaporator vacuum release rate.

(This is the minimum design change necessary for CNP)



Design Change Option #2

Evaporator instrument line vertical design to bring horizontal runs up above maximum solution level, Instrument line pipe material same as dip tubes, Vent line check valve to control evaporator vacuum release rate, and Dip tube changed from horizontal to vertical design to minimize plugging of dip tube.



Design Change Option #3

Evaporator instrument line vertical design to bring horizontal runs up above maximum solution level, instrument line pipe material same as dip tubes, Vent line check valve to control evaporator vacuum release rate, Dip tube changed from horizontal to vertical design to minimize plugging of dip tube, and Surge pot added to limit height solution will rise up in instrument line.