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Rebuttal Testimony and Schedules
David G. Daniels

**BEFORE THE OFFICE OF ADMINISTRATIVE HEARINGS**
**FOR THE**
**MINNESOTA PUBLIC UTILITIES COMMISSION**
**STATE OF MINNESOTA**

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| IN THE MATTER OF AN APPLICATION OF NORTHERN STATES POWER COMPANY FOR AUTHORITY TO INCREASE RATES FOR ELECTRIC SERVICE IN THE STATE OF MINNESOTA | MPUC Docket Nos. E002/GR-12-961<br>E002/GR-13-868 |
| IN THE MATTER OF THE REVIEW OF THE ANNUAL AUTOMATIC ADJUSTMENT REPORTS FOR ALL ELECTRIC UTILITIES | E999/AA-13-599<br>E999/AA-14-579<br>E999/AA-16-523<br>E999/AA-17-492<br>E999/AA-18-373 |

OAH Docket No. 65-2500-38476

REBUTTAL TESTIMONY OF

DAVID G. DANIELS

On Behalf of

NORTHERN STATES POWER COMPANY

September 22, 2023

Exhibit___(DGD-2)

**Steam Chemistry**

## Table of Contents



## Schedules

# I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND EMPLOYER.

A. My name is David G. Daniels. I am a Senior Principal Scientist with Acuren Inspection, Inc.

Q. HAVE YOU PREVIOUSLY PROVIDED TESTIMONY IN THIS PROCEEDING?

A. Yes. On June 16, 2023, I filed my Direct Testimony on behalf of Northern States Power Company (Xcel Energy or the Company) regarding Xcel Energy's water and steam chemistry practices at Unit 3 of its Sherburne County (Sherco) Generating Plant (Plant).

Q. ON WHAT EXPERIENCE IS YOUR TESTIMONY IN THIS PROCEEDING BASED?

A. I have over 40 years of experience with steam and water chemistry, including directly working as a plant chemist at a coal-fired power plant very similar to the Sherco station. As a consultant, I have performed independent evaluations of the boiler and steam cycle chemistry at nearly 100 different power plants. I have published over two dozen articles as a contributing editor on water and steam chemistry topics for Power magazine. I have authored and edited technical documents for the Electric Power Research Institute (EPRI) on water treatment equipment, steam cycle inspection, treating boiler chemical cleaning wastes, steam cycle lay-up and start up, and anime use and degradation in the steam cycle. In addition, I have served on relevant professional committees, including serving as chairman of the American Society of Mechanical Engineers (ASME) Research and Technology Committee on Water and Steam in Thermal Power Systems.

Q. CAN YOU PROVIDE A BRIEF SUMMARY OF YOUR TESTIMONY IN THIS PROCEEDING?

A. I researched the plant chemistry practices, analyzed the data, and interviewed plant personnel to develop a thorough understanding of the Company's chemistry practices specific to Sherco's Unit 3. Based on this research and analysis, I concluded that the Company's practices at Sherco complied with, and in some cases even exceeded, industry practices at similar large, coal-fired units. The Company's water and steam chemistry practices reflect that, as an operator, the Company proactively worked to ensure the proper monitoring of steam chemistry and responded quickly and thoroughly whenever there were signs of contamination of the condensate, feedwater or steam. In short, the Sherco Operations and Laboratory were acting as prudent operators of their equipment. In addition, after thorough review of the materials provided to me between 2000 and the steam turbine failure on November 19, 2011 (Event), I found that the Company prudently monitored the water and steam chemistry at Unit 3, and its practices from 2000 to 2011 were sufficient to identify any significant acute or chronic contamination events that would have warranted removal of the blades and the related inspection discussed by other Company witnesses. No such events were identified.

Q. WHAT IS THE PURPOSE OF YOUR REBUTTAL TESTIMONY?

A. My Rebuttal Testimony replies to testimony filed by Mr. Richard Polich of GDS Associates, Inc. on behalf of the Minnesota Department of Commerce (Department), specifically as it relates to the water and steam chemistry practices and procedures at Sherco 3 and any alleged impact on the Event.

## II. OVERALL RESPONSE TO WITNESS RICHARD POLICH

Q. WHAT OVERARCHING OBSERVATIONS DO YOU HAVE REGARDING MR. POLICH'S TESTIMONY?

A. There are three overarching observations I have that are important context for Mr. Polich's testimony. ***First***, Mr. Polich does not appear to have done any independent review or analysis of the chemistry data related to Unit 3. Instead, his testimony relies on a selective review of the record in a separate proceeding, brought in state court by several insurers against General Electric (GE), the turbine manufacturer (GE Litigation). For example, the perfunctory portion of his testimony that discusses water and steam chemistry appears to rely not on the actual steam chemistry data, but rather solely on reports written by witnesses for GE in the GE Litigation. In particular, in his testimony related to water and steam chemistry, Mr. Polich relies on the ChemStaff Report written by Mr. William Allmon, and in a subsequent Information Request, Mr. Polich points to a report by James D. Schultz. It is my understanding that neither of these GE Litigation witnesses are providing testimony in this regulatory case.

***Second***, Mr. Polich has no experience or training in water and steam chemistry of a fossil-fired power plant. Mr. Polich "does not have any degrees or specific course work in the area of water chemistry," only "understands the fundamentals of proper water chemistry," "does not have any memberships in water chemistry," and is unable to provide any other reports, testimony, or conclusions reached as an expert in water chemistry. (*See* the Department's response to Xcel Energy's Information Request No. 3, included as Exhibit___(DGD-2), Schedule 1.) At most, Mr. Polich has experience reviewing historical water chemistry data, and even then, Mr. Polich was only

able to identify with any specificity his involvement in failure analyses at two coal-fired power plants and one combined cycle plant.[1] The majority of his experience appears to have been at nuclear power plants and combined cycle power plants and unrelated to water chemistry. Both nuclear and combined cycle power plants have steam generator steam cycles that are significantly different than those at a conventional coal-fired plant. As a result, Mr. Polich's experience does not translate to the Sherco 3 system, and as I detail below, that lack of experience is apparent from his testimony here.

*Third*, Mr. Polich mischaracterizes the findings of Thielsch Engineering's root cause analysis report (Thielsch Report)[2] in his testimony on p. 19, line 6. I address the specific mischaracterizations of the Report by Mr. Polich as it relates to water and steam chemistry below. However, my overarching observation is that I have not seen anything to indicate that Mr. Polich himself conducted a root cause analysis, let alone reviewed the relevant steam chemistry data, and therefore he has no basis that I have seen from which to draw any conclusions about the root cause of the Event or, more particularly, about the part the steam chemistry played in the corrosion mechanism.

In short, Mr. Polich's methodology and experience – reflected in his Direct Testimony – do not provide him with a basis to reliably, independently opine on the condition or prudency of the water and steam chemistry program at Sherco 3.

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[1] This experience also appears to be irrelevant here, where Mr. Polich did *not* review the historical water chemistry data.

[2] The Thielsch Report is included in Company witness Anthony A. Tipton's Direct Testimony as Exhibit___(AAT-1), Schedules 2 and 3.

Q. CAN YOU GIVE SOME EXAMPLES THAT DEMONSTRATE MR. POLICH'S LACK OF UNDERSTANDING OF UNIT 3'S STEAM CYCLE?

A. There are several, but I will highlight a few significant examples of the fundamental misunderstandings underlying Mr. Polich's testimony.

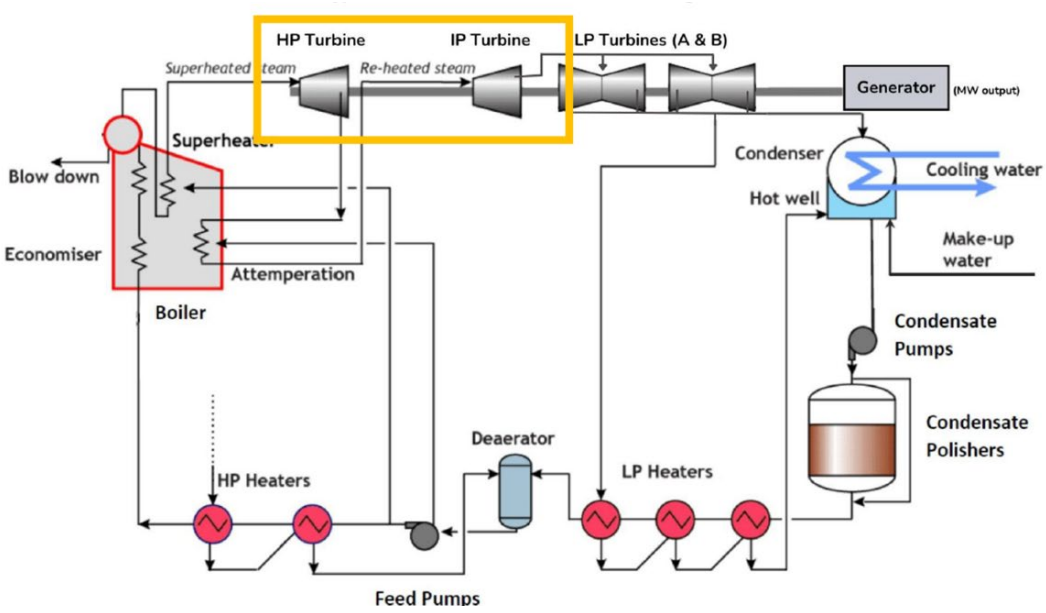
***First***, contrary to his representations, Mr. Polich does not appear to understand fundamental concepts of steam chemistry. For example, he states that "cation conductivity . . . is a measure used to determine chloride concentrations in steam."[3] In reality, cation conductivity is a property of the water that reflects not only the chloride concentration, but also sulfate and other anions such as bicarbonate ($HCO_3$) and organic acids, some of which are not harmful to the steam turbine. In another place in his testimony he simply refers to this measurement as "cation limits."[4] There are cation resins, cation vessels, but there is no such thing as a "cation limit." Further emphasizing the lack of understanding of cation conductivity, Mr. Polich later equates the measurement of cation conductivity with sodium.[5] Sodium and cation conductivity are two completely different measurements, and equating one with the other is wrong. These fundamental errors underscore the unreliability of Mr. Polich's testimony regarding steam chemistry.

***Second***, Mr. Polich does not seem to possess a correct understanding of the steam path through the Sherco Unit 3 turbine, which is no different from the steam path at most similar power fossil-fired plants in the world. He states:

[3] Polich Direct, p. 44 lines 17-18.
[4] Polich Direct, p. 51 line 11.
[5] Polich Direct, p. 50 line 15-16 ("cation conductivity (i.e., sodium concentration)").

"The Sherco 3 steam path flows from the *IP turbine through the reheat section* of the boiler to raise the steam temperature *prior to entering the LP turbine*."[6] (emphasis added). This is wrong. As seen in Figure 1a below (which is Figure 1 from my Direct Testimony with the relevant section identified in yellow), the steam exits the HP turbine and then passes through the reheater before going to the *IP turbine*. There is no reheating of steam after the IP turbine. Mr. Polich makes this basic and fundamental error despite Figure 1 below and Figure 2 in his own testimony which show the correct location of the reheater. This, when combined with his lack of experience and independent analysis, underscores the unreliability of his testimony.

**Figure 1a**
**Diagram of Unit 3's Steam Cycle: HP Turbine to IP Turbine**




[6] Polich Direct, p. 45.

*Third*, Mr. Polich does not appear to fully grasp the chemistry of contaminants in steam. For example, Mr. Polich's testimony on drum boilers (the only relevant boiler to Sherco 3) has a significant gap: it does not consider long-established research from the 1990s showing that the potential for chemical impurities (such as sodium hydroxide) to enter the steam is very low when the operating pressure of the boiler is less than 2500 psig. Mr. Polich appears to be completely unaware of this research, as his explanation of the differences between steam purity in once-through boilers and drum boilers does not recognize that different chemical compounds have different volatility in steam, and that chemical volatility (potential for leaving the boiler water and becoming part of the steam) is impacted by a number of variables, including operating pressure. For example, while my direct testimony discussed this, Mr. Polich's testimony does not address that the Sherco 3 boiler often operated at pressures below 2500 psig, thus limiting the periods when sodium hydroxide (caustic) could even possibly enter the steam, further rendering Mr. Polich's over-simplified understanding of steam chemistry in a boiler and related testimony unreliable.

*Finally*, Mr. Polich confuses the steam chemistry data sources available to Sherco operators. He states: "Sherco 3 was unable to accurately monitor sodium levels of 6 ppb as recommended by GE nor EPRI recommendations of 3-6 ppb."[7] This again is simply wrong. Sherco monitored sodium continuously with on-line analyzers with a detection limit of 0.1 ppb Na at three separate points in the cycle: the demineralizer effluent, the condensate pump discharge, and in the boiler.

[7] Polich Direct, p. 52 lines 7-8.

These examples demonstrate the fundamental lack of experience and understanding that undermine Mr. Polich's testimony.

Q. DO YOU AGREE WITH MR. POLICH'S USE AND DEFINITION OF THE TERM "GOOD UTILITY PRACTICE"?

A. I agree with Mr. Polich that any analysis of utility practices should consider "reasonable judgment in light of the facts known at the time [a] decision was made,"[8] but I otherwise strongly disagree with Mr. Polich's suggestion that "good" utility practices require compliance with every guideline in any EPRI or GE document without considering its date, particular application to a specific unit's equipment, or a utility's specific experience.[9] As Mr. Polich acknowledges, he did not derive his definition from any primary source, (*See* the Department's response to Xcel Energy's Information Request No. 25, included in Company witness Herbert J. Sirois' Rebuttal Testimony as Exhibit___(HJS-2), Schedule 1), and I do not think Mr. Polich is qualified to define "good" utility practice as it relates to water and steam chemistry because he has no experience in this area. He claims no experience in visiting a coal-fired power plants to evaluate their steam chemistry practices and compare them to other similar units.

Q. IS IT YOUR TESTIMONY THAT THE COMPANY'S WATER AND STEAM CHEMISTRY PRACTICES WERE PRUDENT?

A. Yes. Unlike Mr. Polich, I have worked with nearly 100 fossil-fired plants specifically on water and steam chemistry issues over the course of my over 40-year career, including 7 years working directly in the laboratory of coal-fired

[8] Polich Direct, p. 7.
[9] *See* Polich Direct, pp. 47-48 (listing "documentation available . . . that described good utility practice for water chemistry requirements").

power plants, involved every day with water and steam chemistry. I reviewed Xcel Energy's practices, procedures, and data leading up to the Event, and my conclusion is that, overall, the Company's water and steam chemistry program aligned with, and in some cases exceeded, the standards for programs at similar large coal-fired units. Based on the information available to the Company at the time, the Company's water and steam chemistry practices for Sherco 3 fell well within the range of reasonable utility actions.

Q. WHAT DO YOU CONCLUDE FROM REVIEWING MR. POLICH'S TESTIMONY?

A. Mr. Polich's testimony amounts to an inaccurate and incomplete summary of information that he did not personally review, and therefore runs far afield from the expectations associated with expert testimony. Due to his lack of experience with water and steam chemistry issues at a coal-fired plant, combined with his selective review of only a small portion of the available reports and data, Mr. Polich is not qualified to provide testimony on the prudency of the Company's operation of Sherco 3 before the Event. He does not understand how the Sherco 3 system works, including the key steam cycle and chemistry concepts. Without this knowledge and experience, or even an independent review of the relevant data, Mr. Polich cannot know whether the Company was acting as a prudent operator of Sherco 3 with respect to steam chemistry.

## III. XCEL ENERGY'S WATER AND STEAM CHEMISTRY PRACTICES AT UNIT 3

Q. DOES MR. POLICH UNDERTAKE A REVIEW OF THE STEAM CHEMISTRY DATA FROM SHERCO 3 TO SUPPORT HIS CLAIMS THAT WATER CHEMISTRY WAS A "LIKELY CONTRIBUTOR" TO THE EVENT AT UNIT 3?

A. No, there is no indication that Mr. Polich independently reviewed the data on which the ChemStaff Report, provided in the GE Litigation, relied.[10]

Instead, Mr. Polich relies almost entirely on the ChemStaff Report to support his claims that water and steam chemistry at Sherco 3 was a "likely contributor" to the Event.[11] There is no indication that Mr. Polich independently assessed the validity of the claims made in the ChemStaff Report (whose author Mr. William Allmon is not a witness in the current regulatory case) or that he has the competency to do so.

Specific issues with the ChemStaff Report are detailed in my extensive rebuttal in the GE Litigation, refuting many of the claims in that Report. My rebuttal report is attached as Exhibit___(DGD-2), Schedule 2.[12] Mr. Polich does not address any of the problems with the ChemStaff Report.

Q. MR. POLICH CLAIMS THAT THE COMPANY FAILED TO "FOLLOW GOOD UTILITY PRACTICE WITH RESPECT TO MONITORING STEAM CHEMISTRY AT SHERCO 3." HOW DO YOU RESPOND?

A. As I stated above, Mr. Polich lacks the experience and knowledge to define or assess "good" utility practices, as he has defined the term, with respect to water and steam chemistry. In addition, Mr. Polich did not review the Sherco 3 steam chemistry data and has no experience with the day-to-day water and steam chemistry of coal-fired plants. Therefore, any conclusion he reaches with

[10] Polich Direct, pp. 44-45. The ChemStaff Report is attached as Schedule 22 (RAP-D-22) to Polich Direct.
[11] Polich Direct, p. 44-45.
[12] The Company provided this report to the Department in response to Department Information Request No. 2.

respect to "good" utility practice—or prudency—of the Company's steam chemistry monitoring at Sherco is baseless.[13]

The procedures, on-line analyzers, grab sampling locations, and chemistry limits that the Company used at Sherco during this period were prudent. This conclusion is based on my own review of the procedures and data from Sherco 3, as well as my experience working with close to 100 fossil-fired power plants during my over 40 years in this industry.

Mr. Polich's emphasis on the fact that Sherco did not have a separate sample point for the hot reheat steam[14] is irrelevant because the Company already had sufficient monitoring to determine if there was contamination entering the unit without this specific sample point. There was no industry-wide "requirement" for a reheat sample in the steam cycle. Pointing to a single page from a nearly 300-page EPRI 2002 Guidelines, Mr. Polich concludes that failure to monitor this sample point meant that the Company failed to follow "good utility practices." But the Guidelines on which Mr. Polich relies are just that—guidelines, not requirements, and even those guidelines acknowledge that "specific unit characteristics and/or experience" could result in modifications of the(se) Guidelines for a specific unit.[15]

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[13] Polich Direct, p. 45.
[14] Polich Direct, p. 45.
[15] Polich Direct, Schedule 29 (RAP-D-29) at 127 ("Copies of Figures 4-1 to 4-3, ***modified if necessary to reflect specific unit characteristics and/or experience***, ***could be*** included in the plant operating procedures and prominently displayed in the control room, water and steam sample room, and chemistry laboratory." (emphasis added)).

Specific to the reheat sample, the EPRI 2002 Guidelines on which Mr. Polich relies acknowledge that a reheat steam sample may not be available at every plant. Because the reheat sample is the combination of Main Steam plus attemperation spray water added in the reheater, the EPRI 2002 Guidelines stated: "Should this sample point not be available, the steam chemistry may be calculated from the chemistries of the saturated steam and feedwater…."[16] The Company relied on this alternative monitoring method at Sherco 3 in alignment with the EPRI 2022 Guidelines. Indeed, because the boiler design of Sherco 3 required very little reheat attemperation, the Main Steam sample that the Company already monitored was sufficient to meet the Guidelines, and would have been chemically indistinguishable from a reheat sample.[17] As a result, and as Sherco plant chemist Mr. Duane Wold testified, the Company prudently weighed the cost and benefits of adding additional monitoring to existing monitoring and determined that, the sampling points and analyzers they already had were sufficient to determine if there was contamination in the unit; that capability would not be enhanced by the addition of a separate reheat sample.[18] That was a reasonable decision on their part and complied with the EPRI 2002 Guidelines which specifically allowed for such plant-specific adaptations.

Mr. Polich's conclusion further ignores, as I stated in my direct testimony, that this is a *cycle* and that the Company undertook substantial monitoring of the

[16] Polich Direct, Schedule 29 (RAP-D-29) at 95.
[17] This was confirmed by Mr. Allmon, the author of the ChemStaff Report, in the GE Litigation. He testified at trial that he calculated reheat steam sodium by adding attemperator sodium to main steam sodium and concluded that there was not "much of a difference" between the reheat steam sodium and the main steam sodium. An excerpt from Mr. Allmon's trial testimony is included as Exhibit___(DGD-2), Schedule 3.
[18] An excerpt of Mr. Wold's trial deposition transcript is included as Exhibit___(DGD-2), Schedule 4.

entire steam cycle at Sherco 3. The Company had been monitoring the Main Steam sample for cation conductivity since the unit was commissioned, and began monitoring sodium at this sample point in 2008. The Company had also been continuously monitoring sodium at the demineralizer effluent, at the condensate pump discharge, and at the boiler since 1987.[19] Therefore, the Company had the two potential sources of sodium hydroxide contamination at Sherco 3 covered—the demineralizer and a condenser tube leak. It also monitored sodium in the boiler, which concentrates any contamination about a hundred-fold. Thus, even trace amounts of contamination coming in with the feedwater would be obvious in the chemistry of the boiler sample. Shown in Figure 1b below (which is Figure 1 from my Direct Testimony, modified to show all of the continuous monitoring and grab at each sample point on Unit 3) are the grab and continuous monitoring sample location across the steam chemistry cycle at Unit 3.[20]

[19] Polich Direct, Schedule 29 (RAP-D-29) at 95 (providing alternative to reheat sample).
[20] An enlarged copy of Figure 1b is also included as Exhibit___(DGD-2), Schedule 5.

## Figure 1b
## Diagram of Unit 3's Steam Cycle:
## Identifying Chemical Monitoring Locations

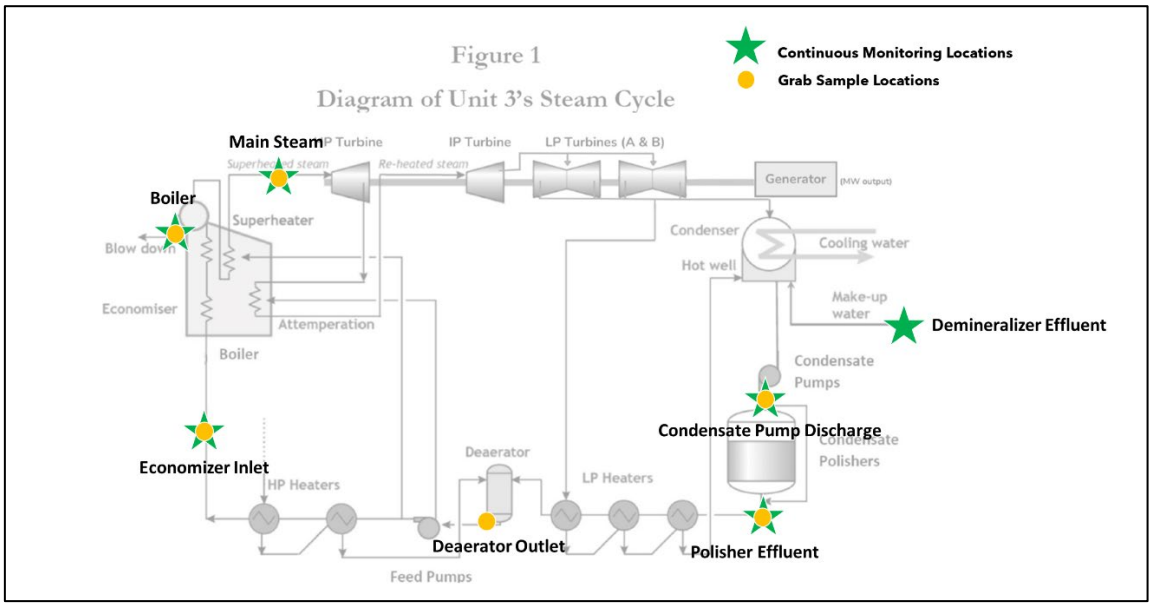


Table 1 below further shows chemical parameters analyzed at each sample location.

## Table 1
## Unit 3's Steam Cycle Chemical Monitoring at Each Sample Location

| Location | Main Steam | Boiler | Economizer Inlet |
|---|---|---|---|
| **Grab Sample Testing** | 1. Sodium (Na)<br>2. Cation Conductivity<br>3. Ammonia<br>4. pH<br>5. Silica<br>6. Specific Conductivity | 1. Sodium (Na)<br>2. Specific Conductivity<br>3. Cation Conductivity<br>4. Silica<br>5. pH | 1. Specific Conductivity<br>2. Cation Conductivity<br>3. pH<br>4. Dissolved Oxygen<br>5. Sodium<br>6. Ammonia<br>7. Silica<br>8. Iron |
| **Continuous Monitoring** | 1. Sodium (Na) (after 2008)<br>2. Cation Conductivity | 1. Sodium (Na)<br>2. Specific Conductivity<br>3. Cation Conductivity<br>4. Silica<br>5. pH | 1. Specific Conductivity<br>2. Cation Conductivity<br>3. pH |

**Table 1 (continued)**
**Unit 3's Steam Cycle Chemical Monitoring at Each Sample Location**

| Location | Deaerator Outlet | Polisher Effluent | Condensate Pump Discharge | Demineralizer Effluent |
|---|---|---|---|---|
| **Grab Sample Testing** | 1. Dissolved Oxygen | 2. Cation Conductivity<br>3. Dissolved Oxygen<br>4. pH<br>5. Silica<br>6. Sodium | 1. Sodium (Na)<br>2. Specific Conductivity<br>3. Cation Conductivity<br>4. pH<br>5. Dissolved Oxygen<br>6. Ammonia<br>7. Iron<br>8. Silica | No routine grab sample testing at this location |
| **Continuous Monitoring** | No continuous monitoring at this location | 1. Cation Conductivity | 1. Sodium (Na)<br>2. Specific Conductivity<br>3. Cation Conductivity<br>4. Silica | 1. Sodium (Na)<br>2. Specific Conductivity<br>3. Silica |

As seen from Figure 1b and Table 1, the Company has monitored key chemical parameters across the water and steam cycle at Sherco 3 to control steam purity. Because these sampling points and analyzers would have alerted Sherco 3 operators to significant contamination, I view these practices at Sherco as reasonable and prudent and sufficient to identify any steam contamination at Sherco 3 that would have required removal of the blades.

Q. DOES EPRI SET REQUIREMENTS FOR FOSSIL-FIRED PLANTS?

A. No, it sets guidelines. It is important to remember that EPRI is an advisory (not regulatory) organization (I have been a contributing author and editor to the organization for decades.). EPRI's chemistry guidelines recommend the *best practices* intended to encompass the entire range of the types of boilers and turbines used by their membership. Their recommended practices are aspirational—intended to improve industry practices among its members and

not to reflect the entire range of *reasonable practices* that can be employed by prudent plant operators.

This is shown through EPRI's documentation. For example, in EPRI's 1986 Cycle Chemistry Guidelines, it expressly states: "These guidelines . . . are not intended to be used as a code or standard. The guidelines . . . can be adapted and customized to a utility's individual situation."[21] It goes on to acknowledge that "[a]ll utilities will not be able to monitor all the parameters at all the sample points nor maintain all the target values and action levels. In each case, monitoring of cycle chemistry should be consistent with the existing sample system, instrumentation, and manpower."[22] EPRI further recommended modification of the guidelines based on "plant-specific" design and "local operating experience."[23] Another EPRI Guideline points to the same cost-benefit analysis that Mr. Wold testified to: "[S]ome units may be currently operating with sufficient availability and efficiency, and without any problems, that additional expenditures or changes in the current treatment cannot be justified."[24] The other EPRI guidelines on which Mr. Polich relies similarly set forth recommendations or suggestions and support plant-specific and experience-based modifications.[25]

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[21] Polich Direct, Schedule 26 (RAP-D-26) at 2.
[22] *Id.* at 3.
[23] *Id.* at 6 ("Modification of portions of the Guidelines to reflect actual, plant-specific design characteristics and local operating experience is recommended when appropriately justified.").
[24] Polich Direct, Schedule 28 (RAD-D-28) at 11.
[25] For example, Polich Direct, Schedule 27 (RAP-D-27) at 4 ("Sampling and control range limitations are suggested on Figure 4-1."); RAP-D-27 at 10 ("If the addition of a downcomer sample is a burden to the utility, the utility may consider using the downcomer sample . . . as a matter of convenience."); Polich Direct, Schedule 28 (RAP-D-28) at 2 ("Sample points, monitoring parameters, target values, and action levels . . . may be modified as appropriate."); RAP-D-28 at 7 "Modification of portions of the Guidelines to reflect actual, plant specific design characteristics and local operating experience is necessary by all

The GE documents that Mr. Polich points to similarly state repeatedly that they are "recommendations," not requirements.[26] They also state up front that they do "not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance."[27]

Q. DOES MR. POLICH CLAIM THERE ARE "OTHER EXAMPLES" OF THE COMPANY'S FAILURE TO ADEQUATELY MONITOR STEAM CHEMISTRY AT SHERCO 3?

A. Yes, but again he relies entirely on the ChemStaff Report for this claim rather than on any independent review of underlying data or documents.[28]

Q. HOW DO YOU RESPOND TO THESE "OTHER EXAMPLES"?

A. The list of Mr. Polich's "other examples of Xcel's failure to adequately monitor steam chemistry at Sherco 3"[29] is simply a list of things he states that the Company did not do, with no context or justification and no consideration of what the Company *did* do. As such, he provides no basis to support a claim that Xcel Energy had an unreasonable chemistry program at Sherco 3.[30] As I stated above, EPRI's industry guidelines are general guidelines on the whole water and steam chemistry system of an idealized unit which must be adapted to individual plant equipment and operating conditions. Based on my extensive experience

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utility users."); RAP-D-28 at 10 ("The purposes of these Guidelines are . . . to provide a document that can be used by utility personnel as a guide in setting up their own AVT operating guidelines for their own unique combination of units and current chemistry control."); RAD-D-28 at 11 ("It is strongly recommended that these Guidelines be customized and modified to reflect local operation experience and conditions.").

[26] Polich Direct, Schedules 25 and 30.

[27] Polich Direct, Schedule 25 at p.1; Polich Direct, Schedule 30 at p. 1.

[28] *See* Polich Direct, p. 46 line 6.

[29] Polich Direct, pp. 46-47.

[30] As I have stated, he also has no experience from which to judge the Company's chemistry program.

and independent review, the Company's water and steam chemistry program for Sherco 3 fell well within the range of reasonable utility actions.

The list of Mr. Polich's "other examples of Xcel's failure to adequately monitor steam chemistry at Sherco 3" is also riddled with unfounded claims and outright falsehoods, which I address below.

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Q. HOW DO YOU RESPOND TO MR. POLICH'S CLAIM THAT "XCEL'S INTERNAL REQUIREMENTS FOR WATER CHEMISTRY WERE NOT FOLLOWED AT SHERCO 3."[31]

A. Here again, Mr. Polich points to a document and section titled "recommendations" and takes the position that they are "requirements." As Mr. Wold acknowledged, the Company considered the need for a reheat sample and determined that its existing program – specific to the unit and chemical monitoring Sherco 3 already had in place – was sufficient to meet the goals of the water and steam chemistry program.[32] Based on my own extensive review of the Company's steam chemistry program and my knowledge of industry guidelines, this was well within the range of reasonable utility actions.

Q. AT PAGES 50 AND 51, MR. POLICH AGAIN PROVIDES HIS INTERPRETATION OF WHAT HE CALLS "CHEMSTAFF'S FINDINGS IN REGARD TO SHERCO 3'S WATER CHEMISTRY PRACTICES." HOW DO YOU RESPOND?

[31] Polich Direct, p. 48.
[32] Exhibit___(DGD-2), Schedule 4.

A. Again, Mr. Polich does not draw any conclusions from his own independent review of available information, but instead summarizes the ChemStaff Report, a Report he did not write or contribute to. Mr. Polich cites the GE Litigation testimony of the Report's author, Mr. Allmon, that "reviewing the available Serco (sic) 3 data collected on sodium, Sherco 3 would have exceeded GE guidelines for sodium 5% of the time and EPRI guidelines 6% of the time."[33] The referenced statement refers to Mr. Allmon's analysis of the main steam sodium analyzer data to which he added a sodium contribution from the reheat attemperation sprays to produce a "calculated" reheat steam result. He then used this data to calculate the number of data points above the EPRI and GE limits of sodium in the reheat steam. In his analysis, Mr. Allmon did not fully account for elevated results due to sampling issues that occur during startup or any instrument maintenance or calibration periods. Considering the number of unit starts and the frequency of periodic maintenance and calibration required on these instruments, if the data collected during these periods were to be omitted, the resulting percentages above the normal limits are not what I would consider unreasonable for an operating power plant. They certainly do not point to a significant contamination event during this period or imprudent operation on the part of Sherco.

Mr. Polich tries to quote the ChemStaff Report regarding the findings on cation conductivity limits on the main steam sample.[34] A complete discussion of the improper assumptions on which the ChemStaff Report relied in order to arrive at these conclusions are detailed in my rebuttal expert report,[35] and in particular

[33] Polich Direct, p.50, lines 13-15.
[34] Polich Direct, Schedule 22 at p. 29.
[35] Exhibit___(DGD-2), Schedule 2 (to this Rebuttal Testimony).

its decision to include chemistry readings taken during unit starts and equipment maintenance in his results, which Mr. Polich again does not even attempt to address. In any event, the cation conductivity of the condensate, feedwater, boiler water or steam are irrelevant to the Event. Chloride and sulfate concentrations, which are approximated by cation conductivity, do not produce caustic-induced stress corrosion cracking. Only the level of caustic in the steam, which is approximated by the sodium concentration, is relevant here. And despite what Mr. Polich claims, cation conductivity is not equal to the sodium concentration in any sample.

Q. MR. POLICH DISMISSES THE THIELSCH REPORT DISCUSSION AND CONCLUSIONS REGARDING THE COMPANY'S WATER AND STEAM CHEMISTRY PRACTICES AS "NOT VALID" AND "WITHOUT MERIT." DO YOU AGREE?

A. Absolutely not. Again, Mr. Polich did not himself actually review the Company's water and steam chemistry practices or data, and has no relevant experience from which to form an opinion. In contrast, I have significant relevant experience, I have reviewed all of the relevant data and documents, and I conducted the chemistry analysis underlying, and agree with conclusions, of the Thielsch Report. Mr. Polich gives no basis for his dismissal of the Thielsch Report or his statement that the Thielsch Report "assumed the monitoring of water chemistry at Sherco 3 was being performed properly, the water chemistry monitoring and testing equipment was properly calibrated, and data was obtained at the correct points in the feedwater and steam cycle."[36]

[36] Polich Direct, pp. 51-52.

The Thielsch Report did not make these assumptions. Rather, the Report relied on my independent review and analysis of the water chemistry practices at Sherco 3, my assessment of the equipment calibration, and my assessment of the sufficiency of the steam cycle monitoring done by the Company.

Mr. Polich also asserts that the Thielsch Report could not be valid because "Sherco 3 was unable to accurately monitor sodium levels of 6 ppb as recommended by GE nor EPRI recommendations of 3-6 ppb."[37] As I stated above, this is simply wrong. The Company monitored sodium continuously at Sherco 3 with on-line analyzers with a detection limit of 0.1 ppb Na at three separate points in the cycle: the demineralizer effluent, the condensate pump discharge, and in the boiler.

Next, Mr. Polich states that "Thielsch never verified the water chemistry monitoring practices or equipment calibration practices of Sherco 3." The online chemistry analyzers were indeed routinely maintained and calibrated. Evidence of this can be found in the calibration logbooks maintained by the plant.[38] The reason for preforming the grab samples was as a second check on the on-line instruments.

The laboratory also calibrated the laboratory instruments they used including the instrument (Flame AAS) used for measuring sodium in grab samples. In this case, the instrument was calibrated every time before it was used. Here again, Mr. Polich's statement is completely at odds with the facts.

[37] Polich Direct, p.52 lines 7-8.
[38] The calibration logs are included as Exhibit___(DGD-2), Schedule 6.

Finally, the Thielsch Report ultimately concluded that the design by GE of the turbines led to high stress during normal operation that led to the Event: "The primary causal factor responsible for the stress corrosion cracking of the low-pressure turbine L-1 disks was the high static stresses generated during normal operation [which] are solely a function of the original design and operation at design conditions. The water chemistry of Unit 3 conformed to EPRI guidelines and was not a significant factor contributory to the stress corrosion cracking …." Nevertheless, Mr. Polich misstates the conclusion of the Thielsch Report, claiming that the Thielsch Report found that the cause of the Event was "pre-existing SCC . . . likely caused by sodium hydroxide."[39] There is no basis for this mischaracterization of the Thielsch Report. Indeed, I understand that in this case, Mr. Tipton's testimony makes clear that that the Event would have occurred even with *pure* steam.

Q. WHAT DOES MR. POLICH STATE IS HIS "CONCLUSION REGARDING THE IMPACT OF SHERCO 3'S WATER CHEMISTRY PROGRAM ON THE SCC FAILURE" OF UNIT 3?

A. Mr. Polich purports to "conclude":

> Sherco 3 failed to monitor and control water chemistry within GE and EPRI guidelines in accordance with good utility practice. This resulted in chemical higher concentrations of caustic chemicals in the steam flowing through the LP turbine and increased accumulation of SCC inducing chemicals on the L-2 – L-0 stages of the LP turbine. Xcel also failed to perform recommended inspections of the LP turbine rotor disks in accordance with industry standards based upon the level of chemicals in Sherco 3's steam. Xcel should have performed the LP rotor inspection and inspected the LP turbine rotor

[39] Polich Direct, p. 19, lines 8-10.

> L-1 disk finger dovetails using MPI in 2011, which would have discovered the high level of SCC and avoided the accident.[40]

In his summary, Mr. Polich similarly claims:

1. Xcel was well aware of the importance of water chemistry and the potential for poor water chemistry to cause stress corrosion cracking in portions of the LP turbine.
2. Xcel did not maintain water chemistry in accordance with industry recommended practices that resulted in sodium induced SCC in the LP turbine rotor L1 disk.

Q. HOW DO YOU RESPOND?

A. I strongly disagree with Mr. Polich's conclusions. ***First***, it is important to note again that Mr. Polich does not have the training, experience, or knowledge of the relevant information in this case to draw *any* conclusion with regard to the reasonableness of the water and steam chemistry program at Sherco 3. And Mr. Polich does not actually present his own conclusions here, relying instead on a report from a different expert, written and used in a different case in a different jurisdiction. It is unclear why the Department chose not to present testimony from ChemStaff, or any other chemistry expert. Mr. Polich's attempt to render testimony not based on his own review and analysis of the underlying facts runs afoul of the standards for expert testimony.

***Second***, Mr. Polich is simply wrong with his main allegation that the Company "failed to monitor and control water chemistry within GE and EPRI guidelines

[40] Polich Direct, p. 53

in accordance with good utility practice" or "did not maintain water chemistry in accordance with industry recommended practices." I have been in this industry for over 40 years, I reviewed the Company's steam chemistry program for Sherco 3, and contrary to Mr. Polich's conclusion, I can confidently state that the Company complied with, and at times exceeded, water and steam chemistry practices at similar large coal-fired units. Moreover, in my review of the chemistry data, the Company maintained water chemistry for Sherco 3 within reasonable limits and were prudent operators. More important than the number of on-line monitors and their locations was the overall importance the plant gave to water and steam chemistry issues. The laboratory was present during every startup of the unit following an outage (regardless of the time of day or night it occurred). Operators were aware of and responded to water and steam chemistry analyzer and equipment alarms. The laboratory always had someone on call to answer questions or come out to the plant, and look at the issue, firsthand as required. And, finally, a complete review of the water and steam chemistry data showed that, during the period in question, Sherco 3 was operated in such a way as to produce good steam purity.

## IV. CONCLUSION

Q. PLEASE SUMMARIZE YOUR TESTIMONY.

A. My testimony focuses on the Company's water and steam chemistry program at Sherco 3 from 2000 through November 2011. I personally researched the plant chemistry practices, analyzed the data, and interviewed plant personnel to develop a thorough understanding of the Company's chemistry practices specific to Sherco's Unit 3. Based on this research and analysis, I first explain (1) that the Company's practices at Unit 3 generally complied with, and in some

cases exceeded, industry practices at similar large, coal-fired units; (2) the Company prudently operated and monitored the water and steam chemistry of Unit 3; and (3) from 2000-2011 there were no significant acute or chronic contamination events which would have sent contaminated steam to the turbine sufficient to have prompted the Company to remove the L-1 blades to inspect the finger dovetail attachments for cracks.

Next, Mr. Polich has none of the day-to-day experience or industry knowledge that would qualify him to provide either a definition of "good industry practices" for water and steam chemistry from 2000 to 2011 or provide qualified testimony regarding whether the Company's water and steam chemistry practices met that definition. In particular, it does not appear that Mr. Polich personally reviewed the available water or steam chemistry data for Sherco 3 before providing his testimony.

Finally, he has misinterpreted or misunderstood the information he has reviewed, in particular the Thielsch Report, in order to reach what appear to have been his foregone conclusions. In so doing, he has repeatedly manifested his lack of understanding of basic water and steam chemistry concepts that anyone should understand to qualify to testify in this area.

Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY?

A. Yes, it does.

**Northern States Power Company, doing business as Xcel Energy**
**Information Request**

| | |
|---|---|
| Docket No.: | E002/GR-12-961, E002/GR-13-868; E999/AA-13-599; E999/AA-14-579; E999/AA-16-523; E999/AA-17-492; E999/AA-18-373; OAH 65-2500-38476 |
| | Sherco 3 |
| Requestor: | Xcel Energy - Tara R. Duginske, Assistant General Counsel, Xcel Energy |
| Requestor email: | Tara.R.Duginske@xcelenergy.com |
| Requested from: | Minnesota Department of Commerce – Richard A. Polich |
| Date of Request: | August 9, 2023 Information Request No. 3 |
| Response Due: | August 21, 2023 |

---

Reference: Direct Testimony of Mr. Richard Polich

Question:

a) State all education, degrees, coursework, memberships, etc. Mr. Polich has in the area of water chemistry.

b) State all experience Mr. Polich has in operating, monitoring, evaluating, or analyzing water chemistry.

c) State all experience Mr. Polich has in analyzing historical water chemistry data.

d) Provide a list of all matters or cases in which Mr. Polich been offered as an expert in water chemistry.

    i. Indicate if any of these matters or cases in which Mr. Polich has been offered as an expert in water chemistry involved the steam path in a fossil unit.

e) Produce all reports, testimony, opinions and conclusions reached for each matter or case in which Mr. Polich has been offered as an expert in water chemistry.

Response:

a) Mr. Polich does not have any degrees or specific course work in the area of water chemistry. Mr. Polich has taken college courses in chemistry, understands

the fundamentals of proper water chemistry, and how it affects materials in the steam turbine. Mr. Polich does not have any memberships in water chemistry.

b) Mr. Polich's experience with steam turbines are discussed in response to Xcel's Information Request No. 2. Some of that experience includes review of water chemistry impacts on plant operations and damage to plant equipment.

c) During the startup of Consumers Energy Campbell 3 power plant, Mr. Polich was part of the team assigned to determine the root cause of the super heater failure. Mr. Polich reviewed the water chemistry data as well as the boiler operational data. The final cause of the super heater failure, which had only been subject to steam conditions for three months, was boiler drum carryover during a power increase and subsequent plant shutdown shortly afterwards. Sodium in the boiler drum was carried over into the super heater and left deposits on the tubes. During the subsequent cooldown and the plant being idle for three days after the carryover, the boiler tubes experienced stress corrosion cracking in the weld areas. Upon startup, the welds failed resulting in the replacement of the superheater. Mr. Polich also analyzed water chemistry data for Plum Point power station as part of assessment of weld failure in the boiler economizer. In assessing the low pressure steam turbine last stage blade failure of Duke Energy Florida's Bartow combined cycle plant, Mr. Polich reviewed historical plant water chemistry data. Mr. Polich has also had discussions with plant personnel at a variety of power plants on water chemistry as it relates to various plant problems.

d) Mr. Polich has not provided direct testimony on water chemistry in regulatory proceedings because the equipment failure presented in his testimony was not related directly to water chemistry. As part of his investigation into equipment failures, Mr. Polich has reviewed water chemistry because of its potential to impact material failure.

e) Not applicable.

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| | |
|---|---|
| Preparer: | Richard A. Polich |
| Title: | Managing Director |
| Department: | Power Supply |
| Telephone: | 501-316-9805 |
| Date: | August 21, 2023 |

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**PUBLIC DOCUMENT**
**NOT-PUBLIC DATA HAS BEEN EXCISED**

Northern States Power Company

MPUC Docket No. E999/AA-18-373, et al.
OAH Docket No. 65-2500-38476
Exhibit___(DGD-2), Schedule 2

## Schedule 2

Exhibit___(DGD-2), Schedule 2 has been marked Not-Public in its entirety. This Schedule was provided by M&M Engineering Associates, Inc. and responds to a report by William Allmon (Allmon Report), on behalf of General Electric (GE) and subject to a confidentiality agreement. GE considers the Allmon Report to constitute confidential and proprietary information to GE. Therefore, the Company considers this Schedule to be trade secret data as defined by Minn. Stat. § 13.37(1)(b) and Xcel Energy maintains this information as a trade secret pursuant to Minn. Rule 7829.0500, subp 3.

Pursuant to Minn. R. 7829.0500, subp. 3, the Company provides the following description of the excised material:

1. **Nature of the Material:** Rebuttal to Expert Opinion of William Allmon Regarding the Effects of Chemistry Control on the Failure of the LP Turbine of Sherco Unit 3
2. **Authors:** David G. Daniels, M&M Engineering Associates, Inc.
3. **Importance:** Responds to confidential and proprietary information of GE and that is subject to a confidentiality agreement between the Company and GE.
4. **Date the Information was Prepared:** March 25, 2016

STATE OF MINNESOTA — DISTRICT COURT

COUNTY OF SHERBURNE — TENTH JUDICIAL DISTRICT
Case Type: Property Damage

AEGIS INSURANCE SERVICES, LTD., AND OTHER INTERESTED INSURERS AS SUBROGEES OF NORTHERN STATES POWER CO. AND SOUTHERN MINNESOTA MUNICIPAL POWER AGENCY,

Plaintiffs,

vs.

GENERAL ELECTRIC COMPANY; GENERAL ELECTRIC INTERNATIONAL, INC.; GE ENERGY SERVICES, INC.,

Defendants.

**JURY TRIAL**

File No. 71-CV-13-1472

**TRANSCRIPT OF PROCEEDINGS**

**VOLUME IX**

The above-entitled matter came duly on for trial before the Honorable Sheridan Hawley, one of the judges of the above-named court, on October 26, 2018, at the Sherburne County Courthouse, Elk River, Minnesota.



*Michelle Pecharich & Leslie Carver*
*Official Court Reporters*

TABLE OF CONTENTS



EXHIBITS





*Michelle K. Pecharich, RPR*
*Official Court Reporter*
*(763) 682-7553*

truncated data, Action Level 3, the plant would have, according to the EPRI guidelines, been shut down within four hours. In the Action Level 2, the plant should have been shut down within 24 hours, and in Action Level 1 here, the plant should have been shutdown within a week. So we have lots of periods here where the plant should have been shut down based on main steam sodium and it was not.

**Q.** And then 1174F?

**A.** So I calculated --

**Q.** Go ahead. Tell us what this chart shows. It says, calculated reheat steam sodium?

**A.** Yes. This is calculated reheat steam sodium. Essentially, it adds the attemperator sodium in for the reheat steam that is not accounted for in main steam.

**Q.** Is there much of a difference?

**A.** No.

**Q.** All right. So did you do an action level analysis on what sodium measurements did exist?

**A.** Yes, I did.

**Q.** And can you refer to your -- refer to your report and tell us what your analysis showed?

**A.** Yes, so the -- in that 12-and-a-half year period they exceeded the GE limits for 774 hours, which is about

CONFIDENTIAL - SUBJECT TO PROTECTIVE ORDER



STATE OF MINNESOTA DISTRICT COURT

COUNTY OF SHERBURNE TENTH JUDICIAL DISTRICT

Case Type : Property Damage

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NORTHERN STATES POWER COMPANY; SOUTHERN MINNESOTA MUNICIPAL POWER AGENCY; AEGIS INSURANCE SERVICES, LTD. and other Interested Insurers as subrogees of Northern States Power Company,

Plaintiffs,

vs. Case No. 71-CV-13-1472

GENERAL ELECTRIC COMPANY; GENERAL ELECTRIC INTERNATIONAL, INC.; GE ENERGY SERVICES, INC.; and GE ENERGY CONTROL SOLUTIONS, INC.,

Defendants.

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

# DEPOSITION OF DUANE S. WOLD
VOLUME I, Pages 1 - 260
DECEMBER 16, 2015

(The following is the deposition of DUANE S. WOLD, taken pursuant to Notice of Taking Deposition, via videotape, at the offices of Gaskins Bennett Birrell Schupp, LLP, 333 South Seventh Street, Suite 3000, in the City of Minneapolis, State of Minnesota, commencing at approximately 8:57 o'clock a.m., December 16, 2015.)

13:22:14 with would be NQ 810131.

13:22:23 Q. Okay. And what's the title of that?

13:22:25 A. And the title is "Piping and Instrument Diagram, Reheat Steam."

13:22:30

13:22:32 Q. Okay. Thank you.

13:22:33 (Witness handing documents to counsel.)

13:22:42 Q. But in any event, after receiving the e-mail on EPR 5.736G, you didn't start monitoring the reheat steam differently than -- Strike that. You hadn't --

13:22:46

13:22:52

13:22:56 You didn't start monitoring the reheat steam after receiving that; right?

13:22:58

13:22:59 A. No.

13:23:01 Q. You continued to monitor the main steam, and what you did is you added a continuous sodium monitor after this; right?

13:23:07

13:23:11

13:23:15 A. Yeah. On main steam.

13:23:17 Q. Right.

13:23:17 And is the reason you added that, is that because of receiving EPR 5.736G?

13:23:20

13:23:29 A. No. I think we had -- I actually a year or two earlier put in for it, capital money for a sodium analyzer, but didn't get it. And so we put it in again and then got it in 2008.

13:23:34

13:23:39

13:23:43

13:23:47 Q. So you were looking at adding a main steam sodium analyzer earlier, and it just was coincident

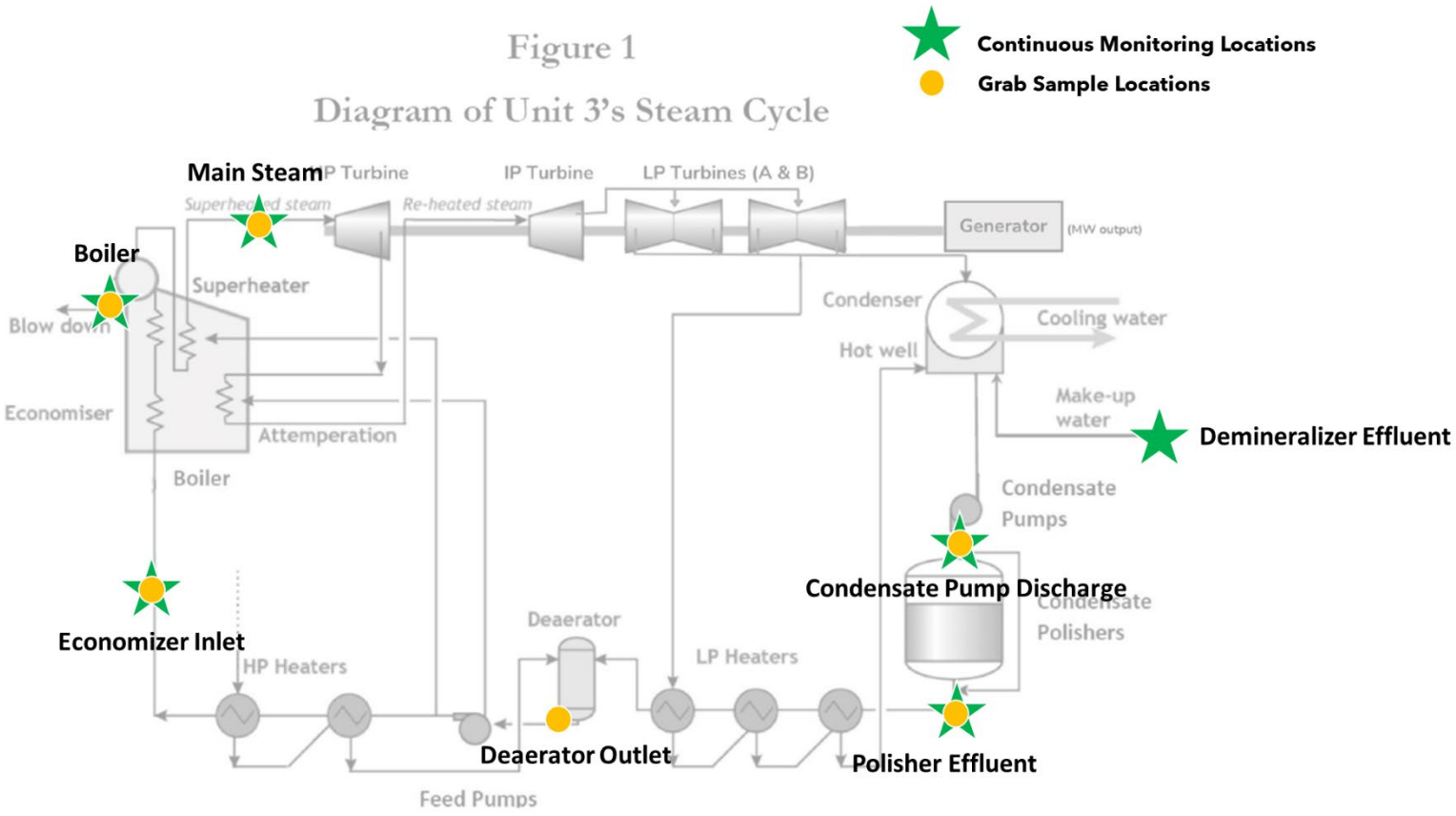
13:23:49

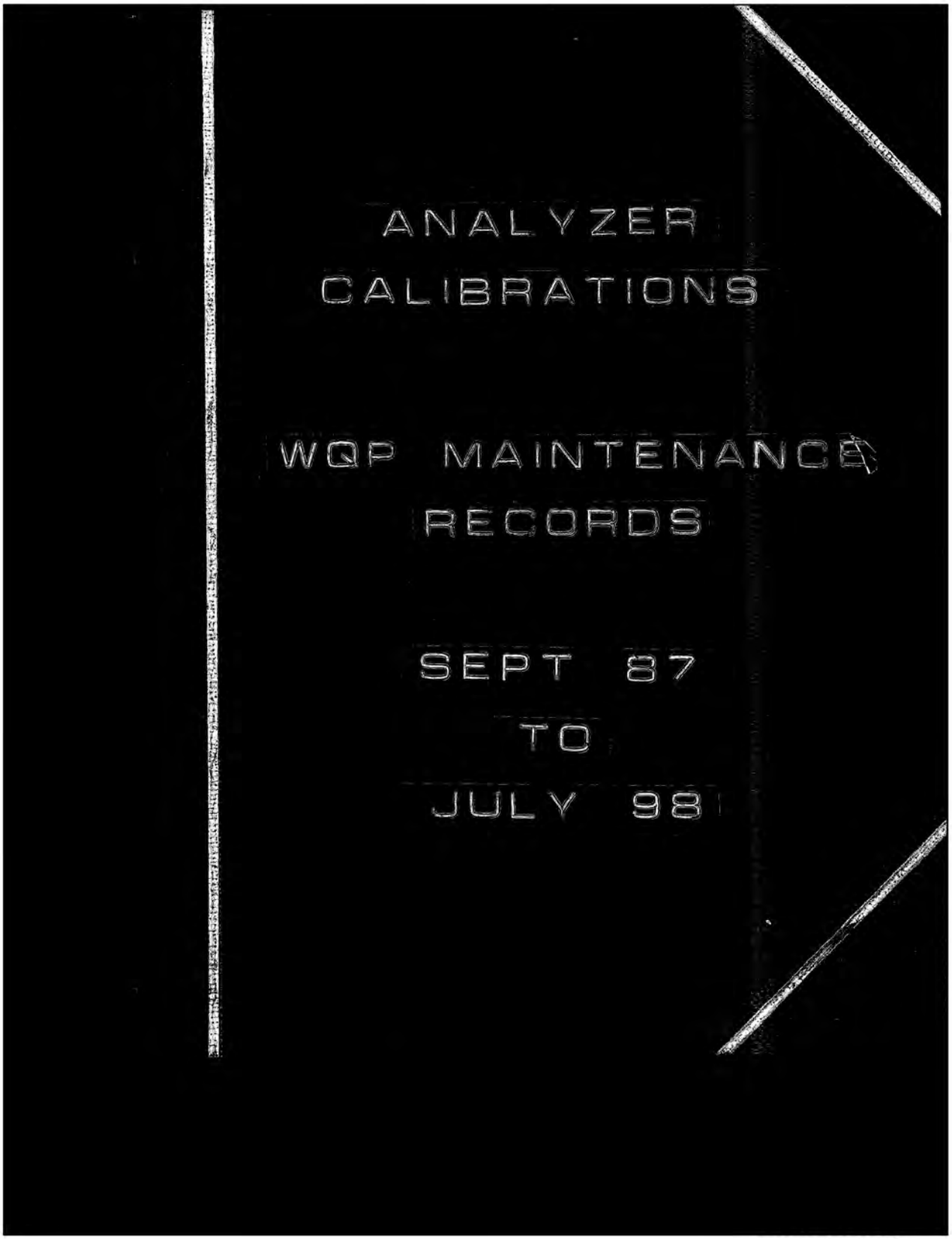
13:23:54 that you received this in 2008 and added the sodium --
13:23:54 A. Yeah.
13:23:57 Q. -- analyzer in 2008?
13:23:59 A. Yeah.
13:24:00 Q. Okay.
13:24:00 A. And the...
13:24:07 Again, you know, it -- I want to emphasize
13:24:10 that in my tenure there I do not believe that we
13:24:16 exceeded the sodium levels in the steam drum --
13:24:20 Q. You're talking about the boiler --
13:24:20 A. Yep.
13:24:22 Q. -- when you talk about the drum; right?
13:24:24 A. Yep.
13:24:25 And the amount of attemperator steam or
13:24:29 water that you use is a very small percentage which
13:24:33 would not considerably add to sodium levels that would
13:24:37 carry over into the turbine. So my -- the whole
13:24:44 premise of -- of recommendations is to try to be as
13:24:49 prudent as you can but be as -- as -- from a economic
13:24:55 standpoint, and at the same time try to weigh the
13:24:59 fruits of benefit to the operation of the plant.
13:25:04 And so if they're recommendations, like
13:25:08 these are, you have to put those into the budgetary.
13:25:12 If they're imminent crisis things that, you know, a
13:25:16 memo is coming up with a red flag and it's blinking at

13:25:21 me you're going to have imminent failure if you don't
13:25:23 do this and follow it to the letter, I wouldn't do it.
13:25:29 Q. Well according to your thinking then the
13:25:31 only places we -- you'd need to monitor would be the
13:25:34 boiler and the condensate pump discharge?
13:25:38 A. I think you could meet the 2 ppb sodium
13:25:43 level at the steam if you monitored the -- the
13:25:46 condensate pump discharge coming out of the condenser
13:25:50 and you monitored the boiler water and you followed
13:25:53 the -- the EPRI guideline limits. They're all based
13:25:57 on -- on good technical science.
13:26:00 Q. Umm-hmm. Okay.
13:26:08 MR. SCHUPP: Would you mark this as the
13:26:09 next one.
13:26:21 (Exhibit 347 marked for identification.)
13:26:21 BY MR. SCHUPP:
13:26:24 Q. You seen this document before, Mr. Wold?
13:26:34 A. (Witness reviewing exhibit.) I can't tell
13:27:30 you if I've seen it before or not.
13:27:31 Q. Okay. Let's just go through the information
13:27:34 and see if it's accurate. The first line says, Na,
13:27:38 sodium online analyzer (initially 2) located on
13:27:41 condensate pump discharge and boiler, main steam added
13:27:44 2008.
13:27:45 That's an accurate statement; isn't it?

# Figure 1b

## Diagram of Unit 3's Steam Cycle Identifying Chemical Monitoring Locations






Wold 000001


XCEL_Sherco_09_0005924

| | |
|---|---|
| 9-2-87<br>CKF, CMK | Both unit One and Two SPD Silica Analyzers were took apart the Delay blocks were Soaked, and new tubing was put in service, and Instruments were calibrated. |
| 9-3-87<br>CKF, CMK | Hydrazine Analyzer probe on unit #1 was replaced and regelled. Unit # 2 probe was regelled. |
| 9-2-87<br>CKF, CMK | Sodium Sleds were calibrated and new filters and Reagent were put in CPD Analyzers on Both Units. |
| 9-4-87<br>CKF, CMK | Sodium Sleds were calibrated and new Filters and Reagents were put in Boiler Analyzers on Both Units. |
| 9-14-87<br>CKF, CMK | Sp. Cond. Cell for unit one Economizer was Cleaned. |
| 9-18-87<br>CKF, CMK | Cleaned delay blocks of # 31 & # 32 Silica analyzers with 1:5 NHyOH. Also replaced tubing ~~Bo~~ for reagents and sample port. |
| 9-21-87<br>CKF, CMK | Calibrated # 31 & # 32 Sodium analyzers. Replaced diffusion tubing and monoethylamine solution prior to calibration. |
| 9-17-87<br>CKF, CMK | Etched # 31 & # 32 Sodium analyzer probes. Refilled reference electrode solutions. |

Wold 000003

4

| | |
|---|---|
| 10/2/87 CKF, CMK | Calibrated #32 Sodium Analyzer. |
| 10/2/87 CKF, CMK | Placed new Hydrazide probe in Hydrazine analyzer #31. Calibrated Analyzer. |
| 10/3/87 CKF&MK | Calibrated #12, #22 Sodium Analyzers. Replaced tygon tubing and soaked delay blocks in KOH solution for #11, #21 Silica Analyzers. |
| 10/5/87 CKF, CMK | Calibrated #11, #21 Sodium Analyzers. |
| 10/9/87 CMK | Replaced Light Bulb in #31 CPD Silica Analyzer. |
| 10/11/87 CMK | Realligned Lamp in #31 CPD Silica Analyzer and Calibrated. |
| 10/11/87 CMK | Calibrated #32 Sodium Analyzer. |
| 10-28-87 CMK | Cleaned anodes and cathode ~~am~~ unit's one and two and the potable Dissolved Oxygen analyzer probes |
| 11/3/87 | New electrode on the Amperometric chlorine titrator |
| 11-9-87 | Found lamp in 11 Silica Analyzer burnt out. Replaced lamp & calibrated it 1300 hrs. Checked flows, etc prior to calibration. |

**Wold 000004**

5

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|---|---|
| 11-10-87 | #12; #21; & #22 Sodium Analyzers were taken out of service for the following:<br>etched the $Na^+$ electrode<br>rinsed & cleaned the reference electrode<br>replaced diffusion tubing<br>replaced monoethylamine jar |
| 11-12-87 | Calibrated #12 & #22 Sodium Analyzers |
| 11-13-87 | Calibrated #21 Sodium Analyzer<br>Calibrated #21 Silica Analyzer |
| 11-18-87 | #11; #31 Sodium Analyzers were taken out of service for the following:<br>etched $Na^+$ electrode<br>rinsed & cleaned the reference electrode<br>replaced diffusion tubing<br>replaced monoethylamine jar |
| 11-19-87 | Calibrated #11 & #31 Sodium Analyzers |
| 11-18-87 | Soaked & cleaned mixing blocks on 32 Silica analyzer. Checked flows & adjusted sample flow thru mixing block to 5ml/min.<br>Calibrated & put back into service. |
| 11-19-87 | Soaked & cleaned mixing blocks on 31 Silica analyzer.<br>Calibrated & put back into service. |

**Wold 000005**

6

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|---|---|
| 11-21-87 RAC | Replaced diffusion tubing and Sodide solution in Hydrazine analyzer #(Unit #3). Found old solution out and diffusion tubing in backwards. |
| 11-30-87 | Regelled cell & calibrated Hydrazine analyzer Unit 1 |
| 11-30-87 | Regelled cell, replaced pleated capsule filter & calibrated Hydrazine analyzer Unit 2 |
| 11-24-87 | Replaced diffusion tubing, iodine solution, and etched electrode, then calibrated Unit 3 Hydrazine analyzer. |
| 12-3-87 | Calibrated CPD 1 & CPD2 Silica analyzers |
| 12-4-87 | Soaked mixing blocks, cleaned capillaries & calibrated 31 Silica analyzer. |
| 12-7-87 | Found the mixing (2nd one) block had a leak near the plug site on 31 $SiO_2$ analyzer. It was repaired with epoxy, cleaned, calibrated & put back in service. |
| 12-8-87 | Soaked mixing blocks, cleaned capillaries & calibrated 11 & 21 Silica analyzers |
| 1-11-88 CKF | Replaced O-rings, diffusion tubing and solution, and in-line filters for #31 and #32 Sodium Analyzers. |

* these two monitors still need to have the $Na^+$ electrodes ~~and~~ etched & then required calibration

Wold 000006

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|---|---|
| 1/15/88 RLM | Unit 1+2 CPD Na Sleds calibrated<br>New electrodes on Unit 2 only.<br>Replaced reagent, tubing, filter, ref. solution |
| 1/19/88 RLM | Unit 1+2 Boiler Na Sleds calibrated<br>Replaced electrodes, reagent, tubing, filter, ref. solution |
| 1/20/88 RLM | Unit 3 Sodium Sleds (CPD + Boiler)<br>Electrode maintenance and calibration |
| 2/24/88 RLM | Changed membrane and electrolyte, polished cathode, cleaned anode. Unit 1+2 orbisphere $O_2$ cells. |
| 3-28-88 | Did an auto calibration on Unit 1 $O_2$ electrode |
| 6-1-88 CKF | Replaced diffusion tubing & iodine solution, reference electrode, and inlet filter for 31 $N_2H_4$ analyzer. Calibrated instrument. Also replaced o-rings. |
| 6-1-88 RAC | Unit #2 Sodium Analyzer - CPD & Boiler rebuilt. Diffusion tubing replaced, solution replaced, filter replaced, column replaced. |
| 6-2-88 RAC | Calibrated CPD & Boiler Sodium Analyzers Unit #2<br>Rebuilt Unit #2 Hydrazine probe.<br>Replaced tubing, cleaned blocks and cleaned analyzers for Boiler and CPD Unit #2 Silica |

Wold 000007

8

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|---|---|
| 6-6-88 RAC | Calibrated Unit #2 Boiler and CPD Silica Analyzers. Took flow going through them and all reagent tanks cleaned and filled with new chemicals. R.A.C. |
| 6-29-88 RAC | Replaced Resin Column(and) Diffusion tubing & Soln, on Unit #1 Boiler & CPD Sodium Analyzers. Replaced ~~CPD~~ Boiler reference and Na probe. ? Ask Roger |
| 6-30-88 RAC | Calibrated Unit #1 Sodium analyzers. They seemed to have came in at appropriate values, system seems OK |
| 7/7/88 CKF | Replaced diffusion tubing and iodine solution; polished iodide probe; calibrated #31 Hydrazine Analyzer. |
| 7/7/88 | Performed the following maintenance on #31 and #32 Sled Sodium Analyzers:<br>- replaced or rings and fuse<br>- replaced diffusion tubing and solution<br>- replaced in-line filters<br>- installed new sodium and reference electrodes |
| 7/8/88 CKF | Calibrated #31, #32 Sled Sodium Analyzers. |
| 7/11/88 CKF | Calibrated and checked reagent levels of #21, #22 Sled Sodium Analyzers. |

Wold 000008

| | |
|---|---|
| 7/11/88 CKF | Rebuilt Unit #1 Hydrazine Cell. |
| 7/11/88 CKF | Cleaned and calibrated 31, 32 Silica analyzers. 31 Silica analyzer not calibrating full range → will investigate further. |
| 7/12/88 CKF | Cleaned delay blocks and calibrated 21, 22 Silica analyzers. |
| 7/13/88 CKF | Cleaned delay blocks and calibrated 11, 12 Silica analyzers. |
| 7/14/88 CKF | Buffered Unit #1 pH probes for boiler and economizer Continuous [redacted] pH meter. |
| | Replaced reference and measuring electrodes for Unit #2 boiler and economizer Continuous [redacted] pH meter. |
| 7/27/88 CKF | Calibrated #11, #12 Sled Sodium Analyzers. |
| 8/3/88 CKF | Cleaned and Calibrated 31, 32 Silica analyzers. |
| 8/3/88 CKF | Replaced o-rings, diffusion tubing, iodide soln, and polished iodide probe on #31 Hydrazine analyzer. |

Wold 000009

10

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|---|---|
| 8/4/88 CKF | Filled reagents and calibrated #31, #32 Sodium Analyzers. |
| | Calibrated #31 Hydrazine Analyzer. |
| 8/10/88 CKF | Replaced in-line filter, o-rings, fuse, diffusion tubing and solution; and etched sodium electrodes for #21, #22 Sodium Analyzers. |
| | Replaced burnt out light bulb for #21 Silica analyzer. |
| 8/11/88 CKF | Calibrated #21, #22, #12 Sodium Analyzers. |
| 8/22/88 CKF | Rebuilt and cleaned Unit 1 & 2 Dissolved Oxygen probes. New membranes installed also. |
| 8/24/88 CKF | Replaced in-line filter, o-rings, fuse, diffusion tubing and solution; and etched sodium electrode for #11, #12 Sodium Analyzers. |
| 8/24/88 CKF | Working with I&C to straighten out calibration problems with #31, #32 Silica analyzers. |
| [illegible] | [illegible] |

Wold 000010

11

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|---|---|
| 8/25/88 CKF | Calibrated #11, #12 Sodium analyzers. |
| 8/25/88 CKF | Calibrated Units 1 & 2 Dissolved Oxygen monitors. |
| 8/29/88 CKF | Replaced in-line filter, o-rings, diffusion tubing and solution for #31 Hydrazine analyzer. Polished Iodide electrode. |
| 8/29/88 CKF | Replaced o-rings, diffusion tubing and solution for #31, #32 Sodium analyzers. |
| 8/29/88 CKF | Cleaned rebuilt, and calibrated Unit #3 D.O. probe and portable D.O. probe. |
| 8/30/88 CKF | Calibrated #31 Hydrazine Analyzer. |
| | Calibrated #31, #32 Sodium Analyzers. |
| 9-8-88 MTB | Calibrated #31 $SiO_2$ Analyzer |
| 9-20-88 | Standardized 11,12 21,22 31,32 $SiO_2$ Analyzers |
| 10-6-88 | Cleaned delay blocks and Cal'd U2 $SiO_2$ analyzers |

Wold 000011

12

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|---|---|
| 10-18-88 | Cleaned delay blocks and calibrated U3 CPD $SiO_2$ analyzer |
| 10-20-88 | Cleaned delay blocks and calibrated U3 Boiler $SiO_2$ analyzer |
| 10-23-88 | New diffusion tubing - O-rings and Solution calibrated #12 $Na^+$ Analyzer CPD |
| 10-25-88 | Replaced pH and reference electrodes on Econ Inlet |
| 10-26-88 | Replaced O-rings, diffusion tubing and solution for 31 & 32 Sodium analyzers |
| 10-26-88 | Standardized 31 & 32 $SiO_2$ Analyzers |
| 11/15/88 | STANDARDIZATION COMPLETED ON:<br>UNIT 3 31, 32 SILICA ANALYZERS<br>UNIT 2 21, 22 SILICA ANALYZERS<br>UNIT 1 11, 12 SILICA ANALYZERS<br>NOTE: BULB BURNED OUT ON 22 |
| 11/21/88 | REPLACED BULB & DESICCANT ON 22 $SiO_2$ ANALYZER (CPD) |

Wold 000012

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|---|---|
| 11/22/88 | REBUILT NO. 31 HYDRAZINE ANALYZER USED 4-DECADE PROCEDURE (ORION SLED) REPLACED: IODIDE ELECTRODE FILTER ASSEMBLY REAGENT DIFFUSION BOTTLE AND TUBING DEIONIZATION CARTRIDGE |
| 12/12/88 | #21 $SiO_2$ ANALYZER CLEANED & STANDARDIZED |
| 12/13/88 | CLEANING & STANDARDIZATION COMPLETED ON #31, #32 SILICA ANALYZERS |
| 12/22/88 | OVERHAULED & CALIBRATED SODIUM (SLED) ANALYZERS ON UNIT 2 (BOILER + CPD) CHANGED OUT: MONOETHYLAMINE BOTTLE + TUBING FILTER pH + REF. PROBES |
| 12/22/88 | CALIBRATED UNIT 1 SODIUM SLED ANALYZERS (BOILER + CPD) |
| 12/28/88 | STANDARDIZED #31, #32 Silica ANALYZERS |

Wold 000013

14

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|---|---|
| 1/6/89 CKF | Replaced lamp on #11 Silica Analyzer. |
| 1/9/89 CKF | Rebuilt hydrazine cell on Unit 2 hydrazine analyzer. |
| 1/11/89 CKF | Filled diffusion solution and checked reference electrode solution, then Calibrated 31, 32 Sodium Analyzers. |
| 1/17/89 CKF | Filled diffusion solution and changed tubing on 31 Hydrazine analyzer. |
| 1/13/89 CKF | Cleaned delay blocks for #31, #32 Silica analyzers. |
| 1/24/89 CKF | Filled reagent levels for #21, #22 Sodium analyzers. Replaced o-rings, diffusion tubing, and reagents for #11, #12 Sodium analyzers. |
| 1/30/89 CKF | Calibrated #11, #12, #21, and #22 Sled Sodium analyzers. |
| 3/13/89 CKF | Rebuilt, retubed, and cleaned #31, #32 Silica analyzers. |

Wold 000014

15

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|---|---|
| 3/15/89 CKF | Replaced o-rings, diffusion tubing, diffusion solution, and in-line filters for #31, #32 Sodium Analyzers and #31 Hydrazine analyzer.<br><br>Etched #31, #32 Sodium measuring electrodes.<br><br>Replaced #31 Hydrazine Iodide and reference electrodes. |
| 3-16-89 RLM | Calibrated #31, #32 Na Sleds and #31 $N_2H_4$ Sled |
| 3-20-89 CKF | Replaced o-rings, diffusion tubing, diffusion solution, and in-line filters for #11, 12, 21, 22 Sodium Analyzers. Etched #11, 12, 21, 22 sodium electrodes. |
| 3-21-89 CKF | Calibrated #11, 12, 21, 22 Sodium Sleds. |
| 4-10-89 SSB | Cleaned; filled reservoirs, checked flows; & calibrated $SiO_2$ analyzers: 21; 22; 11; & 12. |
| 4-11-89 SSB | cleaned & regelled Unit 2 $N_2H_4$ analyzer cell. Replaced pleated capsule filter & tubing. |
| 4-27-89 DSW | 31 & 32 $SiO_2$ analyzers; cleaned & calibrated. |

Wold 000015

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|---|---|
| 5-1-89 | Replaced Unit 1 $N_2H_4$ analyzer pleated capsule filter. I was going to regel the cell, but there was no powder available. |
| 5-2-89 | Filled reagents bottles & calibrated $Na^+$ SLEDS: 11; 12; 21; 22; (31; 32.) 5-4-89 |
| 5-3-89 | Regelled cell on 11 $N_2H_4$ analyzer. Calibrated 5-4-89 |
| 5-10-89 CKF | Cleaned & calibrated #31, 32 Silica analyzers. |
| 5-11-89 RLM | Dissolved Oxygen Monitors Unit 1, 2, + 3 electrodes rebuilt and calibrated. Portable Monitor done in April |
| 5-15-89 | Cleaned & calibrated Silica analyzers: 11; 12; 21 & 22. |
| 5-19-89 | Cleaned & Calibrated Silica analyzers; 31 & 32 |
| 5-31-89 | Calibrated 31 $SiO_2$ analyzer |
| 6-2-89 | Cleaned & Calibrated $SiO_2$ analyzers; 11-12-21-22. |
| 5-31-89 | Cleaned mixing block; capillaries; cell on 32 $SiO_2$ analyzer. Added a splashguard behind the mixing blocks & calibrated it. |

Wold 000016

6-5-89 Etched Hydrazine Electrode; Cleaned $N_2H_4$ ref. elec.; retubed & replaced Iodine bottle and calibrated Unit 3 Hydrazine analyzer.

6-13-89 Etched Na electrode; replaced ref. elec. sol.; replaced diffusion tubing; replaced O-rings. Calibrated 32 Na analyzer (Boiler).

4-89

6-15-89 Etched Na electrode; replaced diffusion tubing & O-rings. Calibrated 31 Na analyzer (CPD).

6-14-89 Cleaned mixing blocks & cell on 31 $SiO_2$ analyzer. Changed Molyb. capillary. Added a splashguard behind the mixing blocks. Calibrated (long form).

6-20-89 Recalibrated Boiler Sodium SLED Unit 3.

6-21-89 #12 Silica Analyzer:
Soaked mixing blocks & sample cell
Replaced ALL tygon tubing
New capillary tubes for reagents.
Fresh reagents in reservoirs
Replaced colorimeter lamp
Calibrated - also new reag. tank filters.

6-22-89 #21 Silica Analyzer

d Same as #12 $SiO_2$ analyzer on 6-21-89 except I didn't change the capillaries, only cleaned them. Calibrated.

Wold 000017

185

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|---|---|
| 6-22-89 | $SiO_2$ analyzer 31 & 32: Soaked & cleaned mixing blocks & sample cell & capillaries. Calibrated both Had I & C check the colorimeter on Blr. |
| 6-23-89 | Regelled the cell in Unit 1 Hydrazine Analyzer. It needs a new pleated capsule filter. |
| 6-27-89 | Regelled the cell in Unit 2 Hydrazine Analyzer. |
| 6-28-89 | Etched $Na^+$ electrode; replaced diffusion tubing, O-rings, replaced in-line filter & deionizing cartridge on 21 Boiler Na SLED. |
| 7-3-89 Cliff | Replaced electrodes (Iodide & Reference), replaced diffusion tubing, solution, and O-rings on 31 Hydrazine analyzer. Calibrated instrument. |
| 7-5-89 | Recalibrated (31) Hydrazine analyzer. |
| 7-6-89 | Replaced deionization Cartridge on 31 Hydrazine analyzer and recalibrated instrument. |
| 7-11-89 | Etched $Na^+$ electrode; replaced diffusion tubing, monoethylamine solution, orings, and in-line filter for 12 & 22 Sodium Sled Analyzers. |

Wold 000018

19

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| 7-13-89 | Calibrated #12, #22 Sodium Analyzers. |
| 7-19-89 | Replaced deionization cartridge, diffusion tubing and solution, in-line filter, $Na^+$ electrode, and reference electrode for #11 Na Sled Analyzer. Etched new $Na^+$ electrode. |
| 7-20-89 | Calibrated #11 Na Sled Analyzer. Replaced in-line filters on #31, #32 $Na^+$ sleds. Filled monoethylamine jars for #31, #32 $Na^+$ sleds. Calibrated #31, #32 $Na^+$ sleds. |
| 7-25-89 | Cleaned & calibrated #31, #32 Silica analyzers |
| 7-27-89 | Filled monoethylamine solution #21 Sled Sodium analyzer and calibrated instrument. Calibrated #11, #21 Boiler Silica Analyzers. |
| 8-2-89 | Replaced diffusion tubing, solution, & o-rings, and calibrated 31 $N_2H_4$ analyzer. |
| 8-2-89 CKF | Calibrated # 21 Sodium analyzer - following a unit outage. |
| 8-9-89 | Silica Analyzers → cleaned & Calibrated #11 & #21 #31 & #32 |

Wold 000019

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|---|---|
| 8-16-89 | 31 Hydrazine Analyzer - Had I&C check out electronics on block thermistor and monitor module. Found corrosion of some degree on most connections. They cleaned it & I calibrated it. |
| 8-16-89 | Cleaned & calibrated 11 & 21 Boiler Silica analyzers. |
| 8-17-89 | #31 & #32 Silica Analyzers<br>The precipitate on the mixing blocks is rapid & very annoying. I called HACH-tech services & they don't know why it's happening.<br>Cleaned & calibrated both of them.<br>I turned the vent fan around on the Boiler Silica analyzer. I suspect the fumes from the Iodine reagent on the $N_2H_4$ SLED may be contributing to the precipitate problem. |
| 8-22-89 | Serviced the Unit 2 Orbisphere probe & calibrated it. |
| 8-23-89 | Unit 1 Hydrazine Analyzer<br>Replaced pleated capsule filter; regelled cell.<br>Calibrated 8-24-89 |
| 8-24-89 | Serviced the Unit 3 Orbisphere probe. Instrument was reading negative numbers. Servicing didn't help. MWR to I&C for electronics check.<br>8-29-89 |

Wold 000020

21

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| 8-29-89 | Cleaned & calibrated #31 Silica Analyzer |
| 8-30-89 | Cleaned & calibrated #32 Silica Analyzer |
| 9-5-89 | #31 & #32 Sodium SLED's:<br>Changed Deionization Cartridge<br>Installed new $Na^+$ electrode & reference electrode<br>Replaced diffusion tubing<br>Topped off the reagent bottle - No stock available<br>Replaced O-rings |
| 9-6-89 | Calibrated #31 & #32 $Na^+$ SLED's |
| 9-6-89 | #22 Sodium SLED (CPD)<br>Replaced O-rings; replaced diffusion tubing; Etched $Na^+$ electrode; replaced reference elec. solution; topped off reagent bottle. |
| 9-7-89 | Calibrated #22 Sodium SLED (CPD)<br>Recalibrated #31 Sodium SLED - reading negative. |
| 9-7-89 | #31 Hydrazine SLED<br>Etched Iodine electrode<br>Replaced: ref. electrode filling solution<br>diffusion tubing<br>iodine reagent bottle<br>reagent bottle: cap; o-rings; lg. o-ring<br>O-ring on electrode holder<br>Calibrated it. |

Wold 000021

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| 9-8-89 | Recalibrated #31 Hydrazine Analyzer |
| 9-8-89 | Cleaned and calibrated #31 & #32 Silica. Turned vent fan on Boiler back to original design. |
| 9-12-89 | Replaced cell in Unit 2 Hydrazine Analyzer. |
| 9-12-89 | Cleaned sample cell on Silica Analyzers: 11; 12; 21; & 22 and calibrated them. |
| 9-13-89 | #12 Sodium SLED: (CPD) Calibrated 9-14-89<br>Replaced $Na^+$ electrode (etched)-twice<br>Replaced reference electrode<br>Topped off reagent bottle<br>Changed O-rings on electrodes only |
| 9-13-89 | #11 Sodium SLED (Boiler) Calibrated *<br>Replaced diffusion tubing<br>Cleaned & ref. elec. & replaced filling solution<br>Etched $Na^+$ electrode<br>Topped off reagent bottle |
| 9-13-89 | #21 Sodium SLED (Boiler)<br>Etched $Na^+$ electrode<br>Cleaned ref. elec. & replaced filling solution<br>Replaced diffusion tubing<br>Topped off reagent bottle<br>Calibrated. |
| | Monoethylamine reagent was short for this month. Not enough for 6 analyzers. |

**Wold 000022**

22

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| 9-15-89 | #21 Sodium Analyzer (Boiler) |
| RLM | Put in a new measuring electrode |
| 9-19-89 | Installed new reference electrode in #21 SLED |
| 9-20-89 | Calibrated #21 Sodium SLED (Boiler). |
| 9-20-89 | Installed new pH & reference electrodes on Unit 2 Economizer Inlet. |
| 9-26-89 | Cleaned & calibrated #31 & 32 Silica Analyzer |
| 9-26-89 | #12 Silica Analyzer<br>Had lost flow at some time. I cleaned the mixing cell & recalibrated it. Put in an MWR for I&C to change the needle valve on the solenoid. |
| 9-27-89 | Found the solenoid on the #11 Polisher to #12 Silica is leaking by & causing part of the problem w the flow for #12 $SiO_2$. I&C will repair - next week.<br>#12 cleaned & calibrated again. |
| 9-27-89 | The backpressure & shut-off valves for the Unit 1 Dissolved Oxygen monitor need repair or replacement. MWR written. |
| 9-27-89 | Replaced the pH measuring & reference electrodes for Unit 1 Economizer Inlet. |

**Wold 000023**

224

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|---|---|
| 10-3-89 | Rebuilt the Orbisphere probes on Unit 3 and for the portable. |
| 10-4-89 | Found, after extensive testing, that the $O_2$ sensing probe for the Unit3 Orbisphere, is not working. There was moisture inside the housing. Kevin LaVoi is working on it. |
| 10-4-89 | Cleaned and calibrated #31 & 32 Silica analyzers. USE ROOM TEMP DI $H_2O$! |
| 10-19-89 CKF | Cleaned #31 & #32 Silica analyzers. Soaked 2 locks in 20% Ammonium Hydroxide Solution. |
| 10-24-89 | Replaced diffusion tubing, o-rings, and diffusion solution on #31 Hydrazine analyzer. Polished iodide electrode. Calibrated instrument. Replaced in-line filter. |
| 10-25-89 | Replaced in-line filters on 11, 12, 21, 22, 31, 32 Sodium Analyzers. Replaced gray cap, o-rings, and diffusion tubing on #32 Sodium analyzers. Filled monoethyleneamine Containers on 11, 12, 21, 22, 31, 32 Sodium analyzers. Calibrated 11, 12, 22, 31, 21, 32 Sodium Analyzers. |

Wold 000024

25

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|---|---|
| 10-27-89 | Cleaned and rebuilt Units 1, 2, 3 Dissolved oxygen probes. Calibrated D.O. analyzers on units 1, 2, 3. |
| 11/3/89 | Replaced tubing and capillaries for #31, #32 Silica analyzers. Soaked and cleaned blocks in NH4OH solution. Calibrated instruments |
| 11/9/89 | Retubed 11, 12, 21, 22 Silica analyzers. Wiped down instruments, rinsed blocks and calibrated 11, 12, 21, 22 silica analyzers. |
| 11/20/89 | Replaced o-rings, diffusion tubing, and solution for #31 Hydrazine analyzer. Polished the Iodide electrode and refilled reference electrode. |
| 11/28/89 | Replaced o-rings, diffusion tubing, and solution for 11, 12, 21, 22 Sodium analyzers. Replaced reference and measuring electrodes and gray cap for #2 CPD sodium analyzer. Replaced ion exchange cartridge for #1 CPD sodium analyzer. Etched sodium electrodes for 11, 12, 21, 22 analyzers. |

Wold 000025

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| 11/29/89 | Calibrated 11, 12, 21, 22 Sodium analyzers. |
| | Replaced o-rings, diffusion tubing and solution for #31 Sodium analyzer. Etched sodium electrodes for #31, 32 Sodium analyzers. |
| 11/30/89 | Calibrated #31, 32 Sodium analyzers |
| 12/6/89 | Cleaned delay blocks and soaked them in ammonium hydroxide solution for #31, #32 Silica analyzers. Calibrated #31, #32 Silica analyzers. |
| 12-14-89 | Cleaned the mixing cells & calibrated Silica Analyzers: # 12, 11, 21, 22. MWR sent for colorimeter on Unit 2 CPD. |
| 12-18-89 | cleaned and soaked delay blocks on #31, #32 silica analyzers also calibrated #31 & #32 silica analyzers |
| 12-18-89 | replaced membrane and calibrated unit 2 dissolved oxygen monitor |
| 12-20-89 CRF | Replaced measuring and reference electrodes for the economizer pH Monitor on Unit 3. |

Wold 000026

27

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| 12-20-89 | removed sample cells from #31 & #32 Silica analyzers and soaked them in 20% ammonium hydroxide solution. Also recalibrated both #31 & #32. |
| 12-29-89 CKF | Polished electrode on #31 Hydrazine Analyzer. Replaced diffusion tubing, o-rings, and solution. |
| 1-2-90 | calibrated #11, #12, #21, & #22 silica analyzers |
| 1-8-90 | replaced membrane and calibrated Unit 3 dissolved oxygen monitor |
| 1-8-90 | - replaced diffusion tubing and o-rings on #32 sodium sled<br>- also topped off monoethylamine on #11, #12, #21, #22 and #31. #32 monoethylamine was changed<br>- put new reference electrode filling solution on all sodium sleds (#11, #12, #21, #22, #31, #32)<br>- calibrated #11, #12, #21, #22, #31 & #32 sodium analyzers |
| 1-10-90 | calibrated #11, #12, #21, #22, #31, #32 silica analyzers |
| 1-10-90 | replaced cell on unit 1 hydrazine analyzer (CKF) |
| 1-15-90 | replaced diffusion tubing & o-rings on #31 sodium sled along with monoethylamine bottle |

Wold 000027

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| 1-22-90 | calibrated #11, #12, #21, & #22 silica analyzers also soaked #31 & #32 silica blocks in 20% ammonium hydroxide solution calibrating them both upon completion of cleaning! |
| 1-23-90 | replaced monoethylamine, diffusion tubing and O-rings on #11 & #12 sodium sleds also calibrated both of them (#11, #12) |
| 1-29-90 | replaced monoethylamine, diffusion tubing and O-rings on #21 & #22 sodium sleds also calibrated #21 & #22 sodium sleds |
| 1-29-90 ? | replaced membrane and calibrated Unit 3 dissolved oxygen monitor |
| 2-7-90 | Unit 3 HYDRAZINE MONITOR CALIBRATED, REPLACE IODIDE SOLUTION AND DIFFUSING TUBING. |
| 2-20-90 | Replaced Hydrazine tubing, solution, calibrated monitor and replaced reference electrode solution. |
| 3-9-90 | Filled monoethylamine sol. calibrated #32 sodium sled. Rinsed and cleaned reference electrode. |
| 3-14-90) | CALIBRATED #21 & #22 SODIUM SLED (COMPLETE OVERALL). |
| 3-15-90 | OVERALLED SILICA ANALYZER UNIT 2 BOILER & CPD. |
| 3-16-90 | REBUILT UNIT 2 OXYGEN ELECTRODE/CALIBRATED. |
| 3-16-90 | [redacted] CALIBRATED #31, 32, 21, 22 SILICA ANALYZERS. |
| 3-16-90 | REBUILT UNIT 3 OXYGEN ELECTRODE // CALIBRATED. |

Wold 000028

3-16-90 CALIBRATED SILICA ANALYZERS (71, 12, 31, 32)

3-20-90 Replaced monoethylamine, diffusion tubing, O-rings, in-line filter and calibrated 32, 11, AND 12 sodium analyzers.

3-21-90 REBUILT OXYGEN ANALYZER (UNIT 2 & 3)
CLEANED CATHODE & ANODE REPLACED MEMBRANE & CALIBRATED.

3-29-90 RECALIBRATED BOILER unit 3 SODIUM ANALYZER. Replaced Caton Column and in-line filter.

3-30-90 Calibrated # 11, # 12, # 21, # 22, # 31, #32 SILICA Analyzers. Cleaned blocks.

April 5 1990
#31 $N_2H_4$ Analyzer
Replaced reagent bottle and, diffusion tubing, and O-rings.
Replaced measuring and reference electrodes.
Checked all flows & I&C checked thermistor, etc.
Calibrated.

April 6 #31, 32, 11, 21 Silica Analyzers
Cleaned delay blocks & mixing cells & calibrated.

4-19-90 #31, 32 $SiO_2$ analyzers — also # 11, 12, 21, 22 were done!
Cleaned delay blocks, mixing cells, & calibrated.

4-24-90 #32 Sodium SLED
Topped off reagent; etched Na elec; filled ref. elec.
Calibrated

Wold 000029

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| 4-24-90 | #31 Sodium SLED<br>Replaced reagent bottle diffusion tubing, O-rings, ref. fill. solution, etched Na elec. Calibrated |
| 4-24-90 | #11 & #12 Sodium SLED<br>Topped off reagent bottle; etched Na elec. Calibrated |
| 4-27-90 | #32 Sodium SLED<br>NEW: Na measuring elec; ref. elec; tubing; O-rings; electrode holder; Demin cartridge; I&C checked electronics & thermistor. Calibrated Cleaned flow regulator 5-3-90 |
| 5-2-90 MTB | Rebuilt $O_2$-Orbisphere probe Unit 3 |
| 5-3-90 | Unit 1 Hydrazine Analyzer<br>Replaced pleated capsule filter; regelled the cell- Calibrated 5-4-90 |
| 5-3-90 | Unit 2 Hydrazine Analyzer<br>Regelled & cleaned the cell<br>Calibrated - 5-4-90 |
| 5-4-90 | Unit 3 Hydrazine Analyzer<br>Etched Iodine Electrodes; replaced ref. elec. filling solution.<br>Replaced reagent bottle; diffusion tubing; all O-rings<br>Calibrated. |

**Wold 000030**

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| 5-4-90 | 21 Silica Analyzer<br>Cleaned mixing cell & calibrated. |
| 5-7-90 | 31 & 32 Silica Analyzer<br>Duane cleaned both of them. Replaced the Molybdate reagent (the filter, tubing, #31 & capillary). Cleaned mixing blocks & cells & then calibrated them. |
| 5-9-90 | 31 Hydrazine Analyzer<br>Etched I⁻ electrode; cleaned & refilled ref. electrode & calibrated it, again! |
| 5-11-90 | #21; 22; 31; 32 Silica Analyzers<br>Cleaned mixing blocks & mixing cells & Calibrated them. |
| 5-15-90 | Rebuilt the $O_2$ sensor in Unit 3 orbisphere Calibrated. I had I&C repipe the drain line, to go directly to the floor drain, instead of up to the header, (reduce syphon action). |
| 5-16-90 | #11, 12, 22 Silica Analyzers<br>Cleaned mixing cells & calibrated. |
| 5-17-90 | Unit 3 Orbisphere - changed probes (port. meter probe now installed) & calibrated. Seems to work better. Suspect bad probe!<br>Unit 2 Orbisphere - sensor cleaned. Calibrated<br>Probe sent back to Orbisphere. |

232

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| 5-23-90 | Unit 1 Boiler pH<br>Changed measuring & reference electrodes. |
| 5-25-90 | Unit 2 Hydrazine Analyzer<br>Crashed at 3:00 PM. Regelled cell & replaced pleated capsule filter. |
| 5-28-90 | Unit 2 Hydrazine Analyzer<br>Replaced cell with a brand new one |
| 5-29-90 | #31, #32 Silica Analyzers<br>Cleaned mixing blocks & cells. Calibrated. |
| 5-30-90 | #11;12;21;22 Silica Analyzers<br>Cleaned mixing blocks & cells. Calibrated. |
| 6-5-90 | #31 & #32 sodium sleds were both calibrated, new in-line filters installed and monoethylamine bottles were topped off. |
| 6-6-90 | #11 & #12 sodium sleds were both calibrated, new in-line filters, new diffusion tubing, o-rings and monoethylamine<br><br>#21 & #22 sodium sleds were both calibrated new deionization cartridges were installed on both along with in line filters, diffusion tubing, o-rings and the monoethylamine bottle |

Wold 000032

33

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| 6-8-90 | Calibrated #11, #12, #21 & #22 silica analyzers also calibrated #31 & #32 silica analyzers |
| 6-15-90 | - cleaned #31 & #32 silica analyzer delay blocks by soaking in ammonium hydroxide solution. calibrated both #31 & #32 (F) wiped them down |
| | - cleaned, rebuilt and calibrated Unit 3 dissolved oxygen probe |
| 6-18-90 | Unit 3 Orbisphere - same as above |
| 6-19-90 | calibrated #11, #12, #21 & #22 silica analyzers |
| 6-19-90 | calibrated #31 & #32 silica analyzers |
| 6-19-90 | replaced deionization cartridge along with reagent bottle, diffusion tubing and o-rings on Unit 3 hydrazine analyzer. Also calibrated U3 hydrazine analyzer |
| 6-21-90 | - calibrated Unit 3 hydrazine analyzer again |
| | - calibrated Unit 3 sodium Boiler sled |
| 6-26-90 | calibrated #11, #12, #21 & #22 silica analyzers |
| 6-28-90 | Unit 3 Boiler Water Sodium A/sled Disassembled & cleaned the flowmeter valve assembly. |

**Wold 000033**

34

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| 7-2-90 | – calibrated #11, #12 & #21 sodium sleds also topped off monoethylamine bottles on those sleds & #22 (which is out of service ∴ not calibrated) |
| | – calibrated #11, #12, #21, & #22 silica analyzers |
| 7-5-90 | Orbisphere – $O_2$ sensor Unit 3 Chemical cleaning, rebuilt, calibrated. It was very dirty! Reading erradically! |
| 7-6-90 | Calibrated Unit 3 Boiler A/SLED Sodium |
| 7-9-90 | Cleaned & Calibrated CPD Silica Unit 3. |
| 7-5-90 | calibrated Unit 3 hydrazine (LLS) |
| 7-10-90 | – calibrated #11, #12, #21 & #22 silica analyzers |
| | – calibrated Unit 3 Boiler silica analyzer<br>– calibrated Unit 3 CPD sodium sled, topped off monoethylamine |
| 7-16-90 | Unit 3 Orbisphere – $O_2$ Probe Chemical cleaning & calibrated |
| 7-17-90 | Unit 3 Econ pH<br>Unit 3 Boiler pH } new measuring & reference electrodes |
| 7-18-90 | rebuilt and calibrated Unit 1 DO probe (chemical cleaned) |
| | calibrated #11, #12, #21 & #22 silica analyzers |

**Wold 000034**

35

7-24-90 cleaned & rebuilt Unit 2 DO probe

7-25-90 - calibrated unit 3 hydrazine analyzer (LLS)
- calibrated #31 & #32 silica analyzers (JPN)
* - changed tubing and reagant bottle and o-rings on unit 3 hydrazine analyzer *

7-31-90 Unit 2 Boiler Sodium
Changed reagent bottle, diffusion tubing bottle cap, O-rings, $Na^+$ elec and ref electrode & calibrated it.

Unit 3
Orbisphere
Installed the $O_2$ sensor we just received from the company. Calibrated. Sent the one that was on it back to Orbisphere.

$N_2H_4$ Analyzer
Regelled the cell. Couldn't get it to span correctly.

8-1-90 Recalibrated #2 Boiler $Na^+$ Analyzer

8-2-90 $N_2H_4$ Check Unit 3

| | MONITOR | LAB |
|---|---|---|
| 8-1-90 | 25 | 21 |
| 8-2-90 0930 | 22 | 29 <adjusted |
| 1230 | 24 | 19 |
| 8-3-90 0730 | 29 | 29 |

Wold 000035

36.

8-3-90 Cleaned & Calibrated all the Silica analyzers.

8-7-90 Unit 1 Hydrazine Analyzer - regelled; calibrated.

*FYI*

Orbisphere $O_2$ sensor Serial Numbers

| | | |
|---|---|---|
| No. 1 | 4751 | (sent out July '90) |
| 2 | 3225 | (in-service Unit 3) |
| 3 | 5921 | (portable) |
| 4 | 5787 | (installed Unit 1) |

8-8-90 Unit 2 Hydrazine Analyzer- regelled; calibrated.

Unit 3 Boiler A/SLED- installed new flowmeter.

8-13-90 Unit 3 Boiler A/SLED
Replaced reagent bottle & diffusion tubing; ref. elec. fill. solution; O-rings; etched $Na^+$ electrode. Calibrated.

Unit 3 CPD A/SLED
Replaced reagent bottle; diffusion tubing; ref. elec. fill. sol; O-rings; etched $Na^+$ elec.
7-14-90 Calibrated

7-14-90 Sodium SLED's #12 & #22
Etched $Na^+$ Electrodes
Replaced: Reagent bottle; diffusion tubing; ref. elec. fill. sol.; O-rings

Wold 000036

37

| | |
|---|---|
| 7-14-90 | Unit 3 CPD $Na^+$ A/SLED<br>Installed new $Na^+$ electrode & ref. electrode, due to inability to calibrate analyzer. |
| 7-15-90 | Calibrated all 3 CPD Sodium Analyzers. |
| 8-20-90<br>CKf | Cleaned & calibrated CPD (3) Silica Analyzer. |
| 8-21-90 | Calibrated CPD (3) $SiO_2$ analyzer |
| 8-22-90 | Regelled the cell for Unit 3 Hydrazine Analyzer. |
| 8-24-90 | Cleaned mixing blocks & cell on Unit 3 Silica analyzers. Calibrated both. |
| 8-28-90 | Boiler Sodium Unit 1<br>Installed new $Na^+$ electrode; ref. electrode.<br>Replaced reagent bottle; diffusion tubing;<br>O-rings;<br>Calibrated |
| 8-29-90 | #11; 12; 21; 22 Silica Analyzers<br>Cleaned mixing cell & calibrated |
| 9-11-90 | #31 & #32 Silica Analyzers<br>Soaked & cleaned mixing blocks & mixing cells.<br>Calibrated Checked & cleaned capillaries |

Wold 000037

38

| | |
|---|---|
| 9-18-90 | Unit 1 Boiler Sodium<br>Topped off reagent & etched Na elec.<br>Refilled ref. elec. & calibrated |
| 9-19-90 | CPD Sodium SLED Unit 1 & 2<br>Topped off reagent; etched Na elec;<br>refilled ref. elec. & calibrated |
| | CPD Silica Unit 2<br>Cleaned & calibrated. |
| 9-21-90 | CPD Silica Unit 2<br>cleaned & calibrated again, found to<br>have low sample flow. |
| 9-24-90 | CPD Silica Unit 2<br>Replaced colorimeter (took old one to I&C<br>for repair - wouldn't calibrate.) Cleaned<br>capillaries, & mixing cell. Replaced dessi-<br>cant cartridge. Calibrated |
| 9-24-90 | CPD Silica Unit 1<br>Replaced lamp; dessicant cartridge;<br>cleaned capillaries; mixing cell. Calibrated. |
| 9-25-90 | #31 & #32 Sodium A/SLED's<br>Topped off reagent; etched Na elec;<br>refilled ref elec & calibrated. |

Wold 000038

39

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|---|---|
| 9-25-90 | #31 & #32 Silica Analyzers<br>Cleaned mixing blocks & mixing cells; replaced floats. Calibrated. Replaced dessicant. |
| 9-26-90 | #21 Silica Analyzer<br>Replaced colorimeter (I & C worked on this one: replaced lamp; range switch) & dessicant cartridge. Calibrated. |
| | #11 Silica Analyzer<br>Cleaned mixing cell; capillaries; replaced dessicant cartridge. Calibrated. |
| 11-13-90 | Unit 2 $N_2H_4$ analyzer<br>Replaced in-line filter; regelled cell; calibrated |
| 11-16-90 | Unit 3 $N_2H_4$ analyzer<br>Replaced in-line filter; regelled cell; calibrated |
| 1-2-91 | Changed monoethylamine bottles, diffusion tubing, o-rings, etched electrodes and calibrated #31 & #32 sodium sleds |
| 1-3-91 | changed monoethylamine bottles, diffusion tubing, o-rings, etched electrodes and calibrated #11, #12, #21 & #22 sodium sleds |
| 1-7-91 | calibrated #11, #12, #21, #22, #31 & #32 silica analyzers |
| 1-9-91 | Rebuilt Unit 3 hydrazine cell (regelled) |

**Wold 000039**

40

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|---|---|
| 1-14-91 | calibrated #11, #12, #21, #22, #31 & #32 silica analyzers |
| 1-15-91 | soaked and regelled a new cell for Unit 3 hydrazine analyzer |
| 1-22-91 | calibrated #11, #12, #21 & #22 silica analyzers<br>cleaned alk delay blocks and calibrated Unit 3 boiler silica analyzers |
| 1-28-91 | rebuilt Units 1 & 2 DO probes and calibrated |
| | calibrated #11, #12, #21 & #22 silica analyzers |
| 1-30-91 | calibrated #31 & #32 silica analyzers |
| 2-21-91 | Calibrated 31 & 32 Silica analyzer<br>Rebuilt and calibrated 31 & 32 Na Sleds Diffusion tubing, o-rings |
| 2/22/91 | Rebuilt and calibrated 11, 12, 21, 22 Na Sleds Diffusion tubing oring<br>calibrated 11, 12, 21, 22 $SiO_2$ analyzers |
| 2/23/91 | Re-calibrated 12, 22 $SiO_2$ analyzers |
| 3/8/91 | Calibrated 11, 12, 21, 22, 31, 32 $SiO_2$ analyzers |
| 3/15/91 | Calibrated 11, 12, 21, 22 $SiO_2$ analyzers<br>rebuilt unit 2 boiler drag valve on WDP |

**Wold 000040**

41

| | |
|---|---|
| 3/27/91 | Calibrated 11,12 / 21,22 $Na$ Sleds and $SiO_2$ sleds |
| 4/5/91 | Calibrated 11,12,21,22 $SiO_2$ analyzers |
| 4/7/91 | Re-built and calibrated 31,32 $Na^+$ Sleds<br>cleaned and rebuilt 31,31 $SiO_2$ analyzer<br>Jim put D.O. probe in service and rebuilt the old one U3 |
| 4/12/91 | Calibrated 11,12,21,22 $SiO_2$ analyzers |
| 4/17/91 | Calibrated 11,12 $SiO_2$ analyzers - cleaned out capillary tubes |
| 4/18/91 | Re-gelled unit 1 and 2 $N_2H_4$ probes |
| 4/23/91 | re-gelled and calibrated U1 $N_2H_4$ probe/analyzer |
| 4/26/91 | Calibrated 11,12,21,22,31,32 $SiO_2$ analyzers |
| 5/6/91<br>CKf | Cleaned and calibrated 31,32 $SiO_2$ analyzers. |
| rings | Replaced o-rings, diffusion tubing and solution, in-line filter and etched $Na^+$ electrodes for Unit 1 & 2 CPD Sodium sleds. (#12, #22) |
| 5/7/91<br>CKf | Calibrated #12, #22 Na Sleds. (Unit #1,2 CPD). |
| | Replaced o-rings, diffusion tubing and solution, in-line filter and etched $Na^+$ electrodes for #11, #21 Sodium Sleds. (Unit 1 & 2 Boiler). |

Wold 000041

42

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|---|---|
| 5/8/91 CKF | Calibrated 21, 11 Sodium Sleds. (Unit 1 & 2 Boiler) |
| 5/14/91 CKF | ~~Retubed~~ Calibrated #11, 12, 21, 22 Silica analyzers. |
| | Retubed #31, 32 silica analyzers and inspected all capillary tubes. |
| 5/16/91 CKF | Calibrated #31, 32 Silica analyzers. |
| 5/20/91 CKF | Topped off monoethylene amine containers and calibrated #31, #32 Sodium Sleds. (Unit #3 Boiler & CPD). |
| | Adjusted Cation Conductivity meters to actual values for Unit #3. |
| | Removed cell from #31 Hydrazine Analyzer for periodic maintenance. Soaking cell in 2% NaOH solution over-night. |
| 5/21/91 CKF | Regelled Unit #3 Hydrazine Analyzer measuring cell. |
| | Cleaned, rebuilt and calibrated Unit #3 D.O. Analyzer. |

**Wold 000042**

43

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|---|---|
| 5/21/91 CKf 1815 | $N_2Hy$ Monitor check Unit #3 mon. 21 ppb results. 27 ppb |
| 5/22/91 CKf | Calibrated # 11, 12 Silica Analyzers. Ran wire through capillary tubes. |
| 5/22/91 CKf | $N_2Hy$ monitor check Unit #3 mon. 21 ppb results 25 ppb |
| 6/3/91 CKf | Calibrated # 31, #32 Silica analyzers. |
| 6/11/91 CKf | Calibrated # 31, 11, 12 Silica analyzers. |
| 6/18/91 CKf | Topped off the monoethylene amine solution containers for 11, 12, 21, 22 Sodium analyzers. Calibrated 11, 12, 21, 22 Sodium analyzers. |
| | Replaced o-rings, in-line filter, mixed bed cartridges, diffusion tubing and solution, and etched sodium electrodes for #31, 32 Sodium analyzers. |
| | Replaced #32 Na electrode and reference electrode. |
| | Calibrated # 31, 32 Sodium analyzers. |

Wold 000043

44

| | |
|---|---|
| 6-20-91 CKJ | Soaked new hydrazine cells in 2% NaOH solution overnight for 11, 21 $N_2Hy$ analyzers. |
| 6-21-91 CKJ | Gelled 11, 21 $N_2Hy$ cells and returned analyzers to service. Replaced filters on $N_2Hy$ analyzers #11, 21. |
| | Cleaned: Unit #2 D.O. probe. (The cathode, anode, & guard.) Polished D.O. probe and put unit back on line. |
| | Calibrated # 31, 32 Silica analyzers. |
| | Calibrated #11, #12 Silica analyzers. |
| 6-21-91 CKJ | This concludes my two month rotation. |
| 7-2-91 AM | REPLACE MEMBRANE AND ELECTROLYTE ON UNIT 3 D.O. ANALYZER. NOISY SIGNAL. MAY NEED ADDITIONAL WORK. |
| 7-3-91 AM | #31 & #32 $SiO_2$ ANALYZERS CLEANED $SiO_2$ BLOCKS, REPLACED CAPILLARY TUBES, AND CALIBRATED. ALSO FILLED WITH REAGENTS. |
| 7-3-91 AM | UNIT 3 $N_2H_4$ CHECK: MONITOR 24 ppb RESULT 24 ppb |

**Wold 000044**

45

7-5-91 CALIBRATED #1 & #2 $SiO_2$ ANALYZERS.
FILLED WITH REAGENTS.

7-15-91 rebuilt U3 DO probe
JPW

7-25-91 FILLED MONOETHYLAMINE SOLUTION BOTTLES.
RAM CALIBRATED BOILER AND CPD SODIUM ANALYZERS.
UNITS 1, 2, 3.

7-25-91 FILLED SILICA REAGENTS ON 31 & 32 $SiO_2$
RAM ANALYZERS.

7-25-91 FILLED MONOETHYLAMINE BOTTLES ON BOILER/CPD
RAM UNIT 2 AND REPLACED UNIT 1 SOLUTIONS.
CALIBRATED BOTH UNIT 1 AND UNIT 2 & 3.
SODIUM ANALYZERS. ALSO REPLACED TUBING
AND IN-LINE FILTERS.

7-26-91 CALIBRATED $SiO_2$ ANALYZERS.
RAM ON [redacted] UNITS 1, 2, 3. (BOILER/CPD)

8-2-91 CALIBRATED $SiO_2$ ANALYZER — UNITS [redacted] 1, 3.

8-9-91 CALIBRATED $SiO_2$ ANALYZERS — UNITS 1 & 3.
8-12-91 REPLACED D.O. MEMBRANE ON UNIT 3.

Wold 000045

46

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|---|---|
| 8-16-91 RAM | FILLED REAGENTS AND CALIBRATE #1,12,31,32 $SiO_2$ ANALYZERS. |
| 8-19-91 RAM | REPLACED MEMBRANE AND ELECTROLYTE ON UNIT 2 D.O PROBE. |
| 8-20-91 RAM | INSTALLED NEW PROBE ON UNIT 2 $N_2H_4$ |
| 8-22-91 RAM | CALIBRATED AND ADDED CHEMICALS TO #31,32 $SiO_2$ ANALYZERS. |
| 8-26-91 RAM | REBUILT UNIT #1 $N_2H_4$ PROBE. |
| 8-26-91 RAM | REPLACED MEMBRANE AND ELECTROLYTE ON UNIT 1 D.O. PROBE |
| 8-26-91 RAM | REBUILT UNIT 3 $N_2H_4$ PROBE. |
| 8-29-91 RAM | REPLACED MONOETHYLAMINE<br>REPLACED IN-LINE FILTER<br>CALIBRATE<br>31,32,11,12,21,22 Na ANALYZERS. |
| 8-29-91 RAM | CALIBRATED $SiO_2$ ANALYZERS - UNITS 1 & 3. |

Wold 000046

47

| | |
|---|---|
| 9-3-91 MTB | ~~Refilled~~ replaced reagent for series 5000 Silica analyzer for Unit 2 |
| 9-3-91 MTB | replaced both sets of reference and pH probes on Unit 3 circ $H_2O$ |
| 9-9-91 MTB | calibrated 11, 12 $SiO_2$ analyzers |
| 9-11-91 MTB | Rebuilt U2 D.O. Probe |
| 9-18-91 MTB | Removed delay blocks, cleaned and calibrated 31, 32 $SiO_2$ Analyzers |
| 9-18-91 MTB | Replaced pH and reference electrodes in North pot on Unit 3 circulating water |
| 9-18-91 MTB | Rebuilt Unit 3 D.O. probe |
| 9-19-91 MTB | Calibrated 11, 12 $SiO_2$ Analyzers |
| 9-27-91 MTB | Cal 11, 12, 31, 32 $SiO_2$ Analyzers |
| 10-1-91 MTB | Cal 31 $SiO_2$ Analyzer |
| 10-2-91 MTB | Replaced diffusion tubing, O-rings, and monoethylamine and calibrated 31, 32 Na Sled |
| 10-2-91 | Re-gelled Unit 3 $N_2H_4$ probe |

**Wold 000047**

48

| | |
|---|---|
| 10-2-91 mrb | Replaced diffusion tubing, orings, monoethylamine and calibrated 11, 12, 22 Na Sled |
| 10-4-91 mrb | Calibrated 21 Na Sled - replaced tubing and orings |
| 10-4-91 | 11, 12 $SiO_2$ analyzer calibrated |
| 10-7-91 mrb | put new measuring and ref electrodes in 31 Na Sled and calibrated it |
| 10-7-91 mrb | calibrated 31, 32 $SiO_2$ analyzers |
| 10-17-91 mrb | Calibrated 11, 12, 31, 32 $SiO_2$ analyzers |
| 11-6-91 | Removed delay blocks and soaked in $NH_4OH$ solution<br>cleaned capillary tubes<br>refilled reagent tanks<br>calibrated #31 & #32 silica analyzers |
| 11-7-91 | calibrated U1 Silica analyzers<br>cleaned capillary tubes<br>refilled reagent tanks<br>replaced bulb in Boiler Silica analyzer<br>replaced CPD silica analyzer (U1) with one of the old ones from Unit 2. → working fine so far |
| 11-11-91 | calibrated #11 & #12 $SiO_2$ analyzers |

Wold 000048

49

| | |
|---|---|
| 11-12-91 | rebuilt and calibrated U1 DO probe |
| 11-13-91 | calibrated #31 & #32 silica analyzers<br>topped off reagent tanks |
| 11-14-91 | calibrated boiler silica analyzer for Unit 3<br>again |
| 11-18-91 | changed O-rings and diffusion tubing (monoethylamine too) on<br>#11, #12, #21 and #22 $Na^+$ sleds |
| | calibrated #11, #12, #21 and #22 $Na^+$ sleds<br>installed new in line filters on #11, #12 and #22<br>$Na^+$ sleds |
| 11-19-91 | changed O-rings, diffusion tubing, monoethylamine<br>and in line filters on #31 and #32 $Na^+$ sleds<br>calibrated #31 and #32 $Na^+$ sleds |
| | installed new electrodes on #11, #12, #21 and #22<br>$Na^+$ sleds. Recalibrated those same sleds! |
| | rebuilt Unit 3 DO probe |
| 11-20-91 | calibrated #31 and #32 Silica analyzers<br>cleaned precipitate off of #31 and #32 Silica<br>analyzers. |
| | Replaced burnt out bulbs on WQP alarm board<br>MWR in for CPD cation conductivity nuisance alarm |

**Wold 000049**

50

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|---|---|
| 11-21-91 | calibrated #11 and #12 silica analyzers |
| 11-27-91 | calibrated #31 and #32 silica analyzers |
| 12-3-91 | calibrated #11 and #12 silica analyzers |
| 12-4-91 | regelled Units 1 & 2 hydrazine cells |
| 12-5-91 | cleaned delay blocks on #31 and #32 silica analyzers in ammonium hydroxide solution<br>calibrated #31 and #32 silica analyzers |
| 12-11-91 | rebuilt U3 DO probe |
| 12-12-91 | calibrated U1 silica analyzers |
| 12-17-91 | put new reagent and standard into U2 Series 5000 silica analyzer |
| | changed deionization cartridges on #21 and #22 $Na^+$ sleds |
| | new reference electrode solution on U1 Boiler $Na^+$ and U2 Boiler $Na^+$ sleds |
| | calibrated #11, #12, #21 and #22 $Na^+$ sleds |
| | calibrated #31 and #32 $Na^+$ sleds<br>changed reference electrode solution on CPD $Na^+$ sled |
| 12-18-91 | calibrated #31 and #32 silica analyzers |

**Wold 000050**

51

| | |
|---|---|
| 12-27-91 | calibrated U1 silica analyzers |
| 12-30-91. | rebuilt U1 DO probe<br>rebuilt U3 DO probe |
| 1-3-92<br>CKJ | Calibrated #31 and #32 Silica Analyzers. |
| 1-6-92<br>JPW | Calibrated #31 and #32 silica analyzers |
| 1-7-92<br>RLM | Cleaned + Calibrated #31 + #32 silica analyzers.<br>Having some problems with span adjustment on #31. |
| 1-8-92<br>RLM | 1811LL Sodium Analyzer<br>- installed new electrodes, sensing + reference<br>- new tubing + reagent<br>- calibration Slope → 59.6<br>* This analyzer now uses a pink or orange colored cesium chloride filling solution for the ref electrode. |
| 1-9-92 | New Unit 3 pH electrodes for Economizer pH installed. |
| 1-10-92<br>RLM | New measuring + reference electrodes for Boiler + Economizer pH installed on Unit 1. |
| 1-13-92 | New measuring + reference electrodes for Boiler pH on Unit 3. |

Wold 000051

52

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|---|---|
| 1-15-92 RLM | Cleaned + calibrated 31 + 32 silica analyzers. |
| 1-21-92 | Changed 31 Pol. cation column resin. Changed 12 Pol, #1 Econ, # 2 CPD cation resin columns. |
| 1-23-92 | Calibrated 11, 12, 21, 22 Na analyzers.<br>* New reagent + tubing<br>* New sample inlet filters.<br>* Etched measuring electrodes<br>* New Demin cartridges on 11 + 12 analyzers |
| 1-24-92 | Calibrated 31 + 32 Na analyzers<br>* New reagent + tubing<br>* Etched measuring electrodes |
| | Cleaned + calibrated 31 + 32 silica analyzers. |
| | Changed 3 cation columns on Unit 2 WQP. |
| | Cleaned + Calibrated 11 + 12 silica analyzers |
| 1-28-92 (27th) | Complete annual maintenance of TRACE Pump Silica analyzer. |
| 2-3-92 | Changed Reagent + tubing on 1811 LL sodium analyzer. Etched measuring electrode. |

**Wold 000052**

53

2-4-92 Performed calibration on 1811 LL analyzer.
Slope = 60.3

2-4-92 Cleaned + calibrated 11 + 12 silica analyzers.

2-6-92 * Cleaned + calibrated 31 + 32 silica analyzers.
* Rebuilt unit 3 dissolved Oxygen probe.
* New reagents put in series 5000 silica analyzer, unit 2.
* Changed 2 cation resin columns.
* Econ Inlet pH monitor needs work (Unit 1) - MWR -

2-17-92 rebuilt and calibrated U1 DO probe

2-25-92 New reagents in Trace Pump Silica analyzer.
* out of standard, DI water in its place.

2-21-92 Calibrated 31 + 32 silica analyzers.
CKF

2-27-92 Calibrated 31 + 32 silica analyzers
* Silica reagents
Changed several cation columns on all 3 units today.

3-2-92 Replaced in-line filter on Unit 3 $N_2H_4$ analyzer.

3-5-92 Changed reagent/tubing/O-rings; etched Na electrode
Calibrated. 1811 LL Na analyzer.

3-10-92 Cleaned & calibrated 31 & 32 $SiO_2$ analyzers.
Soaked all blocks; replaced Molyb cap on 31.
cleaned all

Wold 000053

534

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|---|---|
| 3-12-92 | Cleaned all flow cells in Unit 1/2 Lab. |
| 3-12-92 | Had Kevin L. check out the 31 $SiO_2$ colorimeter. He tuned it. We reinstalled it and calibrated |
| 3-12-92 | A/SLED Na analyzers 12 & 22.<br>Replaced tubing & reagent; new ref. sol'n;<br>etched Na elec; |
| 3-13-92 | Calibrated 12 & 22 A/SLEDS. |
| 3-16-92 | 31 & 32 Na SLED's:<br>Etched Na elec.<br>Replaced reagent; tubing; O-rings; ref. fill. sol'n.<br>Removed/cleaned elec. block on Blr SLED<br>Calibrated both. |
| 3-16-92 | 11 & 12 $SiO_2$ analyzers:<br>cleaned mixing cell; capillary tubes<br>Calibrated both |
| 3-17-92 | Unit 1 Boiler Na SLED<br>Etched Na elec.<br>Replaced; reagent; tubing; O-rings; ref. fill. sol'n.<br>Removed/cleaned elec block<br>Replaced holding screw and fitted cap on reagent bottle.<br>Calibrated.<br>Replaced entry port and recalibrated. |

Wold 000054

55

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|---|---|
| 3-18-92 | Unit 1 $N_2H_4$ analyzer<br>Regelled cell & replaced in-line filter. |
| 3-19-92 | Calibrated 11 & 12 $SiO_2$ analyzers |
| 3-23-92 | Cleaned 31 & 32 $SiO_2$ analyzers<br>Replaced Amino Acid; tubing; capillary 31 $SiO_2$<br>There are calibration problems on both of these. |
| 3-22-92 | Kevin Lavoi checked & cleaned all of the electronics on 11;12;31;32 A/SLEDS. Recalibrated. |
| 3-26-92<br>RLM | Rebuilt dissolved oxygen probe for Unit 1 WQP.<br>"Chemical Cleaning" |
| 3-27-92 | Still lots of problems with Unit 3 $SiO_2$ analyzers. |
| | Regelled $N_2H_4$ cell on Unit 3. |
| 3-26-92 | Monthly Maint. of TRACE. / Shut down 5000 $SiO_2$ B/r 2 |
| 3-30-92 | Cleaned/Calibrated #11;12;31 $SiO_2$ analyzer |
| 4-6-92 | Unit 1 Boiler Silica<br>Replaced colorimeter lamp & calibrated |
| | Unit 3 Boiler Silica<br>Replaced $H_2O$ capillary & screw. Cleaned the blocks & calibrated it.<br>Unit 3 CPD - cleaned mix. cell / calibrated it! |

Wold 000055

55

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|---|---|
| 4-3-92 | 1811 LL Na Analyzer<br>Etched electrode; replaced bottle & tubing for reagent; replaced ref. sol'n, O-rings<br>Calibrated. SLOPE = 60.5 |
| 3-26-92 thru 4-11-92 | Unit 2 Outage Work<br>5000 Silica Analyzer - Emptied/Out for extended |
| 3-26 | shutdown. Replaced: reagent filters & caps; tubing |
| | from manifold to cell cover; reagent valve fittings |
| | on Amino F & sample; colorimeter lamp; reagents; |
| 4-8 | std; Tried a calibration & a 50ppb std: it |
| | wouldn't do it (unable to cal) Found out from |
| | HACH, the lowest std used should be a 100ppb. |
| 4-10 | Calibrated on 500ppb std = 501 ppb |
| 3-31-92 | $N_2H_4$ Analyzer - Out of Service<br>Replaced in-line filter. Cleaned cell holder; |
| | cell; flow meter. Soaked cell overnight in |
| | 2% NaOH. Regelled cell 4-6-92. In service & |
| 4-6 | Make-up $H_2O$. |
| | Dissolved Oxygen - Orbisphere |
| 3-31-92 | Out of service |
| | Electronically cleaned probe / chemical soak |
| 4-1 | Rebuilt probe - stored in $NaSO_3$ |
| 4-9 | In-service and calibrated |
| | Removed cat. cond. resin col. & B.J. placed |
| | new unit in back panel. |

Wold 000056

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|---|---|
| 4-1-92 | A/SLED Na Analyzers Boiler & CPD |
| 4-2-92 | Etched Na electrodes / soaked. |
| | Cleaned out ref. electrodes/replaced fill. sol'n. |
| | Replaced reagent bottle & tubing & all O-rings |
| | Removed & cleaned electrode block & flowcells. |
| | Replaced in-line filters. |
| | Blr - Replaced cal. entry port & fitted bottle cap |
| | CPD - Replaced fitted cap and holding screw. |
| 4-9 | Calibrated both - placed in service. |
| 4-10-92 | Unit 3 Boiler |
| | Installed new 5000 Series Silica Analyzer |
| 4-11-92 | Calibrated! std = 508ppb Put in service. |
| 4-13-92 | Zeroed/calibrated Trace Silica - Molybdate delivery hose was out of sol'n / triggered alarms. |
| 4-14-92 | 31 & 32 $Na^+$ A/SLEDs |
| | Topped off reagents and calibrated. |
| 4-14-92 | Installed new control box on 5000 $SiO_2$ Unit 3 Blr. |
| | Calibrated ≈ 500ppb std = 511 ppb |
| 4-21-92 | Installed/Calibrated 5000 Series $SiO_2$ analyzer |
| | Boiler - Unit 1 500ppb Std = 491.8ppb |
| | Old 1234 B/D from Unit 1 Blr - torn apart, cleaned, new: tubing, capillaries, filters (reagent) & o-rings. |

**Wold 000057**

58

| | |
|---|---|
| 4-22-92 | Unit 3 CPD Silica Analyzer<br>Rebuilt. Replaced: blocks, tubing, reagents, reagent-filters & o-rings. Calibrated. |
| 4-23-92 | #12 CPD $Na^+$ A/SLED<br>Topped off reagent & calibrated |
| 4-27-92 | #11 Boiler $Na^+$ A/SLED<br>Topped off reagent. Replaced ref. electrode due to unsuccessful calibration. Kevin cleaned all the contacts & ISA. Old dynamic calibrater is broken, sent in for repair. |
| 5-1-92 | Calibrated Unit1CPD & Unit 3 CPD $SiO_2$ analyzers. |
| 5-6-92 | Etched electrode and calibrated 1811 LL $Na^+$ analyzer. Slope → 58.9<br>$E_o$ → -71.8<br><br>calibrated U1 silica analyzer and topped off reagent tanks |
| 5-8-92 | changed reagent and standard on U2 Series 5000 silica analyzer. Set to autocal and returned to service<br><br>calibrated U3 CPD silica analyzer and topped off reagent tanks |

Wold 000058

59

| | |
|---|---|
| 5-12-92 | replaced standard on U3 series 5000 silica analyzer. Also ran auto cal → calibration value at 0000 hrs 5-11 was 392, new cal value is 490 ppb! |
| 5-15-92 | calibrated U1 and U3 silica (CPD) analyzers topped off reagent tanks on U3 |
| 5-19-92 | transferred Betz chemical at 1 & 2 lab new nitrogen bottle for $N_2H_4$ transfer to measuring tank |
| 5-20-92 | topped off U2 Nat sleds monoethylamine bottles. Still waiting on dynamic calibrater to come back from servicing |
| | cleaned and calibrated U1 CPD silica analyzer also topped off reagent tanks |
| | changed in-line filters and deionization cartridges on #31 and #32 sodium sleds |
| 5-27-92 | changed reagents and standard on trace pump silica analyzer |
| 5-31-92 CKf | Calibrated and rinsed 32 Silica analyzer. |
| 5-29-92 | replaced reagents on U3 silica analyzer (Series 5000) |

Wold 000059

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|---|---|
| 6-2-92 | topped off monoethylamine bottles on U3 $Na^+$ sleds (Dynamic calibrator still not back) |
| 6-3-92 | replaced monoethylamine on U1 Boiler and CPD $Na^+$ sleds. Also replaced diffusion tubing, o-rings and in line filters on both sleds. calibrated both sleds also. |
| 6-3-92 | replaced monoethylamine, diffusion tubing, o-rings and calibrated U2 Boiler and CPD $Na^+$ sleds |
| 6-3-92 | calibrated U1 CPD silica analyzer and topped off reagent tanks |
| 6-4-92 | replaced monoethylamine, o-rings and diffusion tubing on 18112L $Na^+$ analyzer. Also etched electrode and calibrated<br>Slope → 60.6<br>$E_o$ → -76.1 |
| 6-4-92 | replaced monoethylamine, o-rings and diffusion tubing on U3 $Na^+$ analyzers. Also etched electrodes and calibrated |
| 6-4-92 | rebuilt Unit 1 DO probe (Serial Number ↓) |
| | sent U3 dynamic calibrator to Orion for repairs (#QP22D) |
| | sent spare DO probe to orbisphere for check and modifications (Model 2110, #5921) |

**Wold 000060**

61

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|---|---|
| 6-5-92 | replaced in-line filter on Unit 3 hydrazine analyzer sample line |
| | rebuilt and cleaned U3 DO probe |
| 6-9-92 | replaced reagents and standard on U2 Series 5000 Boiler silica Analyzer. Also switched to the long cycle program instead of the short cycle |
| 6-10-92 | regelled U3 hydrazine cell |
| | replaced reagents and standard on U1 Series 5000 Boiler silica analyzer |
| 6-18-92 | replaced burnt out bulb on U1 CPD silica analyzer, calibrated and topped off reagent tanks |
| 6-24-92 | replaced reagent on trace pump silica analyzer |
| | calibrated U1 CPD silica analyzer and topped off reagent tanks |
| 6-26-92 | transferred Betz chemical at 1 & 2 lab |
| 7-2-92 | etched electrode and calibrated 18 1122 Na+ analyzer<br>Slope → 61.6<br>$E_o$ → -76.8 |

Wold 000061

62

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|---|---|
| 7-6-92 | new standard in U3 Series 5000 silica analyzer |
| 7-7-92 | topped off reagent pans on U1 CPD and U3 CPD silica analyzers |
| 7-8-92 | rebuilt U2 DO probe |
| 7-13-92 RLM | * New pH + ref. electrodes installed on Unit 3 Econ.<br>* Replaced reagents in Unit 2 series 5000 silica analyzer. |
| 7-16-92 RLM | * Charged cation columns, unit 2 boiler + polishers<br>* Filled reagent tanks, old silica analyzers. |
| 7-20-92 RLM | * New reagents in Unit 3 series 5000 silica analyzer. |
| 7-21-92 RLM | All 4 sodium Sleds in Unit 1+2 lab.<br>* new reagent and tubing<br>* etched Na sodium electrodes<br>* calibrated with 1 ppm std. |
| 7-22-92 RLM | Unit 3 Na analyzers:<br>* new reagent and tubing<br>* etched Na electrodes<br>* calibrated |
| 7-23-92 RLM | * New reagents in Trace Pump Silica analyzer.<br>* New reagent + tubing in 1811LL Na analyzer. Etched $^{Na}$ electrode.<br>Calibrated: slope → +59.3<br>$E_o$ → −74.0 |

Wold 000062

63

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|---|---|
| 7-23-92 RLM | * Filled reagent tanks on 12 and 32 silica analyzers. Calibrated.<br>* Changed unit 1 boiler cation cond. column. |
| 7-29-92 RLM | * New Reagents - Unit 1 Boiler Silica analyzer<br>* Changed 2 cation resin columns - Unit 3 WQP |
| 7-30-92 RLM | * Changed 3 cation resin columns - Unit 1 WQP<br>* Changed 2 resin columns - Unit 2 WQP<br>* added reagents to #32 + #12 silica analyzers. |
| 8-11-92 | * New silica std. in Unit 2 series 5000. |
| 8-18-92 RLM | * Replaced reagents on Trace Pump Silica Analyzer<br>Installed new tubing in pinch valve area.<br>Replaced 2 pieces of tubing from the mixing block that were coated with the moly blue color.<br>* New silica std. in Unit 1 series 5000. |
| 8-25-92 RLM | Maintenance performed on Trace Pump Silica Analyzer due to calibration problems:<br>* removed sample piston and cleaned sample cell<br>* soaked mixing block in $NH_4OH$<br>* replaced a leaky fitting on the piston, new teflon tape |
| 8-27-92 RLM | Calibrated 1811LL Sodium Analyzer<br>Slope → 60.6 |

Wold 000063

134

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|---|---|
| 8-28-92 RLM | * Changed a couple cation resin columns<br>* Topped off silica reagent tanks<br>* Took Trace Pump Silica analyzer out of service. seems to be a problem in the mechanical pinch system. Suction to reagent pistons will not come open very much, if at all. |
| 9-2-92 RAM | * (CHANGED) ADDED REAGENTS ON UNIT 2 BOILER $SiO_2$ ANALYZER.<br>* ADDED MONOETHYLAMINE TO UNITS 1,2,3 $Na^+$ ANALYZERS. |
| 9-4-92 RAM | REPLACED AMINO ACID REAGENT ON UNIT 3 BOILER $SiO_2$ ANALYZER. ADDED REAGENT TO CPD $SiO_2$ ANALYZER ON UNIT 3.<br>REPIPED CPD THROUGH CPD AFTER CHEMICAL FEED SPEC. COND. PROBE ON UNIT 3. WILL DISASSEMBLE FOR OVER LABOR DAY WEEKEND AND REASSEMBLE ON TUESDAY OF NEXT WEEK. |
| 9-3-92 RLM | I+C repaired the mechanical problem with the TRACE Pump Silica analyzer. Placed back in service. ON 9-8-92, it appears that "standard" and "zero" calibrations were performed successfully all weekend. Operation looks good. |
| 9-8-92 RAM | CLEANED, CALIBRATED AND FILLED REAGENTS ON UNIT 3 CPD $SiO_2$ ANALYZER. |
| 9-8-92 RAM | LAST FRIDAY, 9-4-92 I CHANGED THE CPD AFTER CHEMICAL FEED SAMPLE TO THE CPD SAMPLE. |

Wold 000064

65

9-8-92 THE SET POINT WAS ALSO LOWERED TO 5.
HOPEFULLY THE $NH_3$ FEED WILL CONTROL [redacted]
MORE PRECISELY AS MORE OBSERVATIONS
TODAY: INCREASED TO .6-.5 ON 9-14-92

9-9-92 UNIT 1 START-UP

9-10-92 CHANGED RESIN ON CPA 21 POLISHER (UNIT 2)

9-12-92 CHECK REPLACE UNIT 1 BOILER pH PROBE. ECONOMIZER (UNIT 1)

9-14-92 ADJUSTED SPECIFIC CONDUCTIVITY ANION CATION
CONDUCTIVITY MONITORS ON UNIT 3 TO
AN AVERAGE OF TWO MONITORS.

REBUILT D.O. PROBE ON UNIT 3.

9-15-92 REPLACED pH AND REFERENCE ELECTRODES ON:
UNIT 1 ECONOMIZER
UNIT 2 BOILER
UNIT 2 ECONOMIZER
UNIT 3 ~~ECONOMIZER~~ BOILER

9-16-92 CALIBRATED AND FILLED REAGENTS ON
UNIT 2 $SiO_2$ ANALYZER.
CALIBRATED pH PROBES ON UNITS 1 & 2.

9-18-92 UNIT 1 OUTAGE BEGAN AT 0700.
TOOK ALL ANALYZERS OUT OF SERVICE.
PLACED ALL PROBES IN PROPER STORAGE SOLUTIONS.
FILLED $N_2H_4$ SOLUTION TANKS ON UNITS 1, 2, 3.

9-21-92 REBUILT Na ANYLZERS ON UNIT 3.
REPLACED PROBES, FILTERS, MONOETHYLAMINE SOLUTION, TUBING &
CALIBRATED.

Wold 000065

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9-22-92 CLEANED, CALIBRATED, AND ADDED REAGENTS TO UNIT 3 CPD ANALYZER. CHANGED CATION RESIN COLUMN ON UNIT 2. TRANSFERED BETZ CHEMICAL.

9-23-92 CHANGED RESIN ON 31, 32, & 33 CATHOON COND. MONITORS.

9-25-92 REPLACED REAGENTS ON TRACE PUMP $SiO_2$ ANALYZER

9-26-92 REBUILT UNIT 3 $N_2H_4$ PROBE.

9-28-92 REPLACED MONOETHYLAMINE SOLUTION & CALIBRATED THE BOILER AND CPD $Na^+$ ANALYZERS ON UNIT 2.

9-29-92 CALIBRATED AND FILLED REAGENTS ON UNIT 3 $SiO_2$ ANALYZER. ALSO CLEANED CAPILLARIES.

10-5-92 REBUILT UNIT 1 BOILER & CPD $Na^+$ ANALYZERS. REPLACE REFERENCE & MEASURING ELECTRODE ON CPD $Na^+$ ANALYZER.

10-6-92 REBUILT D.O. PROBE— REPLACED ELECTROLYTE & MEMBRANE.

10-19-92 REPLACED BULB IN BOILER UNIT #1 CPD $SiO_2$ ANALYZER.

10-20-92 CALIBRATED $Na^+$ ANALYZER ON THE DEMINERALIZER.

10-21-92 REPLACED REAGENTS & CALIBRATED DEMINERALIZER $SiO_2$ ANALYZER. ALSO ETCHED ELECTRODE.

10-21-92 ADDED MONOETHYLAMINE SOLUTION TO UNIT 1 & 2 SODIUM ANALYZERS. ALL WERE ALSO CALIBRATED.

10-23-92 ADDED MONOETHYLAMINE SOLUTION TO UNIT #3. SODIUM ANALYZERS. ALSO CALIBRATED.

10-23-92 CLEANED, ADDED REAGENTS AND CALIBRATED UNIT 3 CPD $SiO_2$ ANALYZER.

Wold 000066

67

10-26-92 CHANGED REAGENTS AND CALIBRATED UNIT 3 BOILER $SiO_2$ ANALYZER.

10-26-92 ADDED REAGENTS AND CALIBRATED UNIT 1 CPD $SiO_2$ ANALYZER - INITIAL START-UP COMPLETED.

10-29-92 REBUILT UNIT 2 $N_2H_4$ PROBE.

11-9-92 Replaced in-line filters on Unit 3 Blr Na and $N_2H_4$ analyzers.

11-9-92 Rebuilt DO Probe for Unit 2

11-10-92 Calibrated Unit 2 Orbisphere.

11-10-92 Silica 5000 Series Std Conc. Check

| | auto-cal 500ppb | 100ppb | 50ppb | 10ppb |
|---|---|---|---|---|
| U-3 Boiler | 497.7 | 105.4 | 54.4 | 13.3 |
| U-2 Boiler | 500.4 | 107.7 | 57.7 | 17.1 |
| U-1 Boiler | 497.8 | 106.7 | 56.3 | 14.1 |
| U-1 CPD | 497.7 | 103.6 | 53.8 | 9.4 |

11-13-92 I've been working on the Trace Pump $SiO_2$ analyzer all week. The system looses sample flow then flow, once established, is so low it wont successfully calibrate.

Wold 000067

656

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|---|---|
| 11-16-91 | Series 5000 Silica Analyzer for Unit 3 CPD is in service & calibrated 497.7 ppb=500 ppb |
| 11-17-92 | TPA is still malfunctioning. Cleaned mixing block & replaced tubing/fit. |
| 11-19-92 | Monthly maint. on 1811L Na analyzer. Etched elec. Replaced: tubing, O-rings, fill sol., reagent Calibrated ✓ 58.8 SLOPE |
| 11-19-92 | TPA cannot successfully calibrate. |
| 11-23-92 | Purged lines in TPA and increased sample flow to 100mls/min. Now IT WORKS!? |
| 11-24-92 | Unit 3 CPD $SiO_2$ 5000 is in-service and calibrated - 501.2 ppb on 500 ppb std. |
| 11-30-92 | TPA has lost all flow. Disconnected at inlet- NO FLOW. |
| 12-2-92 | Unit 3 A/SLED's Blr & CPD: Etched Na elec; refilled ref. electrodes; replaced monoethylamine reagent; diffusion tubing; all O-rings. Soaked elec. holder in HCl for Boiler to clean off rust. Calibrated both. |

Wold 000068

89

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|---|---|
| 12-3-92 | Replaced reagents in TPA.<br>Overhauled sample piston. |
| 12-7-92 | Unit 1 Boiler Na analyzer.<br>Replaced: ref. electrode, ref. elec. fill. solution<br>reagent & diffusion tubing<br>etched electrode |
| 12-14-92 | Unit 1/Unit CPD Na analyzer<br>U-1 changed Na elec & ref elec.<br>Replaced: reagent & diff. tubing<br>U-2 Etched Na elec; filled ref. elec.<br>Replaced in-line filter<br>Calibrated. |
| 12-15-92 | Unit 2 Boiler Na<br>Replaced: Reagent, tubing, O-rings, in-line<br>filter, ref. elec. fill. sol'n.<br>Calibrated. |
| 12-17-92 | Unit 1 Blr $SiO_2$ - changed reagents |
| 12-23-92 JPW | Monthly maint. on 1811L Na analyzer<br>Calibrated - 58.7 slope |
| 12-31-92 | Unit 1 CPD $SiO_2$ - changed reagents |
| | HAPPY NEW YEAR! |

Wold 000069

70.

1993

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|---|---|
| 1/6/93 ckf | - New reagent for Series 5000 #32 CPD;<br>- New reagent for Trace Pump Analyzer.<br>- Changed #11, #12 Polisher Resins for cation conductivity |
| 1/18/93 ckf | New reagent for Series 5000 #11 Blr;<br>New reagent for Series 5000 #22 CPD.<br>Calibrated both monitors after changing reagents. |
| 1/19/93 ckf | Re-gelled unit 1 and 2 hydrazine analyzers. |
| 1/20/93 ckf | Re-gelled Unit 3 hydrazine analyzer. |
| 1/26/93 ckf | Re-tubing Trace pump analyzer. System alarm → std pump failure. & Piston failure. |
| 2/3/93 ckf | Replaced tubing, orings, monoethylamine solution, and etched sodium electrodes for 11, 12, 21, 22, 31 and 32 sodium sleds. Replaced mixed resin beds for 12, 21, and 22 sodium sled analyzers. Topped off reference electrode solutions as needed. |
| 2/2/93 ckf | Replaced reagent for 21 Silica monitor. (Series 5000) |
| 2/8/93 ckf | Replaced reagent for 12 Silica Series 5000 Analyzer. |
| 2/5/93 ckf | Re-tubed #12 Sled Sodium Analyzer, the portion running from the block to the mixed resin bed column. Also replaced in-line filter for #12 Sled Sodium analyzer. |
| 2/9/93 ckf | Replaced reagent for 31 Silica Series 5000 Analyzer. |

Wold 000070

71

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| 2/10/93 CKf | Polished, electronically cleaned, replaced solution and membrane for Unit One and Unit 2 D. O. Analyzers. |
| | Calibrated # 11, 12, 21, and 22 Sodium Analyzers. |
| 2/12/93 CKf | Calibrated #31, and #32 Sodium Analyzers. |
| 2/16/93 CKf | Replaced monoethylamine, diffusion tubing on the 1811 $Na^+$ Analyzer. Attempted to calibrate but was unsuccessful. May be due to the fact that I etched the $Na^+$ electrode this morning. Will try calibration again. |
| 2/17/93 CKf & RLM | Found, air pump assembly failed. New part on order. The air pump assembly is needed for proper mixing during calibration. This is the reason for calibration failure. |
| 2/26/93 CKf | Calibrated Unit 1 and 2 D.O. Analyzers. Replaced reagent for # 11 Silica analyzer and calibrated instrument. |
| 3/2/93 CKf | Replaced air pump assembly on $Na^+$ Analyzer for Demin. Calibrated. Slope = ERROR Mv. |

Wold 000071

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|---|---|
| 3/4/93 Mm | CALIBRATED BOILER AND ECONOMIZER pH PROBES ON UNIT 1. |
| 3/8/93 Mm | CALIBRATE 1811 $Na^+$ ANALYZER FOR DEMINERALIZER. SUCCESSFUL CALIBRATION. |
| 3/9/93 Mm | BUILT NEW $D.O_2$ MEASURING SYSTEM ON UNIT 2 D.O. D.O. PROBE CAN BE PATCHED-IN TO PATCH BOARD AND MEASURED DIRECTLY OFF HERE WITH FLOW METER, VALVE, AND D.O. ASSEMBLY CONNECTED TO THE ASSEMBLY. |
| 3/18/93 Mm | CHANGED REAGENTS ON BOILER & CPO $SiO_2$ ANALYZERS ON UNITS 1 & 2. |
| 4/16/93 | CALIBRATED, CHANGED MONOETHYLAMINE & DIFFUSION TUBING IN ALL $Na^+$ ANALYZERS EXCEPT UNIT 3 BOILER $Na^+$ ANALYZER. |
| 4/21/93 | REPLACED MONOETHYLAMINE SOLUTION AND DIFFUSION TUBING ON UNIT 3 BOILER $Na^+$ ANALYZER AND CALIBRATED. |
| 4/21/93 | CHANGED REAGENTS IN $SiO_2$ ANALYZERS ON UNITS 1 AND 2. |
| 5-4-93 | Cleaned Nupro in-line filter on U3 DO sample line it was plugged up and restricting the flow<br><br>replaced $SiO_2$ standard on U1 Series 5000 Boiler Silica analyzer. It was unable to calibrate, successful calibration with new standard |

Wold 000072


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| 5-4-93 | submitted an mwr for pressure relief valve replacement on U2 Boiler Silica analyzer |
| | replaced and calibrated a DO probe on U1 (previously rebuilt) cleaned and rebuilt the spare probe that I removed from U1. |
| 5-7-93 | Replaced reagents on U1 and U2 CPD silica analyzers |
| | Replaced filling solution on U1 Boiler Nat sled |
| 5-11-93 | soaked and regelled U3 hydrazine cell |
| 5-14-93 SS | Replaced unit 3 $N_2H_4$ cell. Soaked overnight in 2% NaOH, regelled, installed, stabalized, & calibrated Fri. PM. |
| 5-18-93 | replaced monoethylamine, diffusion tubing, o-rings, in-line filters, deionization cartridges and etched electrodes on #31 and #32 Nat sleds |
| | calibrated both #31 and #32 Nat sleds |
| | installed new in-line filters on U1 & U2 $N_2H_4$ analyzers |
| | replaced reagents and standard on Trace Pump Silica analyzer |
| 5-19-93 | etched electrodes also changed diffusion tubing, monoethylamine, o-rings & in-line filters on all U1 & U2 Nat sleds. Calibrated U1 & U2 Nat sleds |

**Wold 000073**

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|---|---|
| 5-19-93 | changed reagents on U3 CPD Series 5000 silica analyzer |
| 5-20-93 | replaced standard on U3 CPD Series 5000 |
| 5-26-93 | 1811LL Nat Analyzer Maintenance<br>- changed tubing, o-rings & monoethylamine<br>- etched electrode<br>- new reference solution<br>- calibrated (slope → 58.6, $E_o$ → -74.7) |
| 6-1-93 | installed and calibrated a DO probe on U3 |
| 6-2-93 | replaced standard on U1 & U2 Boiler silica analyzers |
| | replaced reagents and standard on U3 Boiler silica analyzer |
| | transferred Betz chemical at U1 & U2 lab |
| 6-3-93 | installed new pH measuring and reference electrodes on U1 Boiler pH |
| 6-4-93 | Kevin LaVoi rebuilt U2 economizer drag valve |
| 6-9-93 | rebuilt and cleaned the new DO probe and calibrated it for U3. The new one seems to work better for U3. |
| | cleaned and rebuilt the spare DO probe so it is ready |

**Wold 000074**

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|---|---|
| 6-11-93 | replaced reagents on U1 and U2 series 5000 Boiler silica analyzers |
| 6-15-93 | replaced reagents and standard on the Trace Pump Silica Analyzer |
| 6-17-93 | installed and calibrated a DO probe for Unit 2. (Was rebuilt on 6-9-93) |
| 6-22-93 | topped off monoethylamine and calibrated all U1 and U2 $Na^+$ sleds |
| | topped off monoethylamine and calibrated U3 Boiler and CPD $Na^+$ sleds |
| 6-23-93 | 1811LL $Na^+$ Analyzer Calibrated<br>- etched electrode<br>- calibrated (Slope → 60.5, $E_o$ → -75.1) |
| 6-24-93 | changed reagents on U3 CPD series 5000 silica analyzer |
| 6-29-93 | replaced bulb on Trace Pump Silica Analyzer |
| | replaced standard on U1 Boiler Series 5000 Silica Monitor |
| | replaced reagents and standard on U1 and U2 CPD Series 5000 Silica Analyzers |

76

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|---|---|
| 7/22/93 MTB | Rebuilt and Calibrated 1811LL Na Analyzer (Slope = 61.3 / $E_0$ -75.5) |
| 7/21/93 MTB | put new membrane on and calibrated $O_2$ monitor on U2 |
| 8/3/93 MTB | Rebuilt and calibrated all Na+ sleds for Units 1 & 2 |
| 8/16/93 MTB | Rebuilt and cal'ed 31 & 32 Na sleds |
| 8/25/93 MTB | Rebuilt U3 NaHg probe |
| 8/26/93 MTB | Calibrated 1811LL Na analyzer / Slope 61.3 ÷ $E_0$ -78.4 |
| 9/8/93 CKF | Replaced reagents for #31 $SiO_2$ analyzer. Replaced $SiO_2$ standard for #12, 22 analyzers. |
| 9/13/93 LLS | Reset Trace Pump Silica Analyzer for 21 days before required maintenance - system alarm cleared. |
| 9/29/93 EHD CKF | New Na, Ref electrodes, diffusion tubing, o-rings, MEA solution, and in line filters for #31, #32 Sodium Sleds. |
| 9/30/93 CKF | New Na electrode # 12, 21, 22 sleds. New ref electrode # 21, 22 sleds. New MEA & diffusion tubing & in-line filt. # 11, 12, 21, 22 |

Wold 000076

77

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|---|---|
| 9/30/93 CLF | Calibrated # 11, # 21 Sleds. |
| | ~~Replaced~~ Replaced Na & Ref electrode, for Demin. New diffusion tubing & MEA. |
| 9/30/93 CLS | Calibrated # 31, 32 Sodium Analyzer. |
| 10/1/93 CLF | Calibrated # 12, 22 Sleds. |
| 10/4/93 CLF | Replaced $SiO_2$ standard on # 32 $SiO_2$ monitor. |
| | Replaced reagents on Trace Pump Silica analyzer and reset system for 28 days. |
| 10/5/93 CLF | ~~Reba~~ Re-gelled Unit 2 Hydrazine cell. |
| 10-12-93 | Checked out Unit 2 CPD A/SLED. Thought the ref. elec. was bad. NOT. The flow was still in calibration mode. Changed it, recalibrated, works fine. |
| | Changed cation columns: Unit 2 CPD, 22 Pol. |
| | 1811LL Demin $Na^+$ may have an electrical problem. I reset the electronics & it seems to do what it's supposed to, but it won't calibrated correctly. Will try again. |

**Wold 000077**

78

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|---|---|
| 10-13-93 | Found a broken cable on Na electrode on 1811LL. BJ fixed it. Etched Na elec. Calibrated 10-14-93 Slope=60.4 $E_0$-55 |
| 10-14-93 | Boiler U-1 $SiO_2$ analyzer "Unable to Calibrate" - cleaned cell, reag. feed tubes. Checked flows for all. Good! Std reading too low. On advice from HACH- found stir motor unable to rotate stir star. BJ removed motor, found magnet moved down shaft (too far apart to move star), raised magnet, reinstalled. |
| 10-15-93 | Tried calibration - didn't work. Too hi 630 |
| 10-15-93 | U-3 $N_2H_4$ - 3 different cells have been installed. Not funtional yet. Pump in manual @ 15% for WEEK-end. |
| 10-18-93 | $N_2H_4$ may have a pump problem. #32 MWR was complete, but after being placed in-service, tripped after 10 min. MWR reissued. |
| 10-18-93 | Tried another auto-cal on U-1 Boiler got 480 ppb |
| 10-19-93 | U-3 Blr $SiO_2$ - replaced $SiO_2$ Std. |
| 10-19-93 | U-1 Blr $SiO_2$ - auto cal - 505ppb ★ Cleaned sample cell - wet outside Drain tube hose clamp loose - leaked |

**Wold 000078**

79

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|---|---|
| 10-19-93 | Changed cat. col. resin on Pol 21. Cleaned flow cells on Unit 1,2,3. |
| 10-20-93 | U-1 CPD $SiO_2$ - reagent replacement. |
| 10-22-93 | U-2 CPD $SiO_2$ - reagent replacement |
| 10-25-93 CKF | Cleaned Unit 3 $O_2$ probe, replaced membrane, and calibrated. |
| 10-29-93 CKF | Replaced reagents on 31 $SiO_2$ analyzer |
| 11-1-93 CKF | Replaced reagents on Trace Para analyzer for Dr min. Replaced Moly III tubing and primed line. Reset for 28 days. |
| 11-4-93 RAM | REBUILT O.O. PROBE ON UNIT 1. |
| 11-9-93 RAM | ADJUSTED FLOWS ON UNIT 1 BOILER — A HIGHER WGP BOILER FLOW WITH THE SAME BACK PRESSURE RESULTED IN A LOWER O.O. VALUE → (5ppb) THE INITIAL D.O. VALUE WAS 8.0ppb. SUSPECT A PROBLEM WITH THE BACK PRESSURE OR MAIN FLOW VALVE. |
| 11-12-93 RAM | ADDED MONOETHYLAMINE TO UNIT 3 Na ANALYZERS. |
| 11-16-93 RAM | REPLACED $SiO_2$ REAGENTS - BOILER $SiO_2$ ANALYZER UNIT 1 |

Wold 000079

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|---|---|
| 11-16-93 LLS | Unit 1 Boiler $SiO_2$ - 5000 SERIES Replaced lamp; sample cell; sample cell cover assembly & calibrated 464 ppb |
| 11-16-93 RAM | REPLACED REAGENT UNIT 1 BOILER $SiO_2$ ANALYZER. |
| 11-17-93 RAM | REPLACED REAGENTS AND STANDARD — UNIT 2 BOILER $SiO_2$ ANALYZER. REPLACED STANDARD — UNIT 2 CPD $SiO_2$ ANALYZER. ADDED MONOETHYLAMINE TO UNIT 1 AND 2 SODIUM ANALYZERS. REPLACED ELECTRODE FILLING SOLUTION ON #21 SODIUM ANALYZER. |
| 11-18-93 RAM | REPLACED $SiO_2$ STANDARD ON UNIT 2 BOILER $SiO_2$ ANALYZER. REPLACE IN-LINE FILTER ON UNIT 3 BOILER $Na^+$ ANALYZER. |
| 11/24/93 CKF | Replaced MEA, tubing, o-rings, and $CsCl_2$ on Demin $Na^+$ analyzer. Etched Sodium electrode. Calibrated; slope = 58. $E_0$ = -60 |
| 11/24/93 CKF & Bryan Johnson | Trace pump silica analyzer lost prime again for the Moly III reagent. Took Moly III section apart and cleaned holder, replaced o-ring to try to reestablish flow. Also replaced connections and piston. Primed Moly III and calibrated. |
| 11/30/93 RAM | CHANGED RESIN ON ECON, CPD, 21 POLISHER CAT. COND. ANALYZERS. |

Wold 000080