West Point Treatment Plant
Instrument Air and Service Air

Scope Definition Technical Memorandum (REVISED FINAL)

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King County Department of Natural Resources and Parks, Wastewater Treatment Division

West Point Treatment Plant Instrument Air and Service Air

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Acronyms and Abbreviations

cfm	cubic feet per minute
County	King County
hp	horsepower
IA	instrument air
OGADS	oxygen generation and dissolution system
O&M	operations and maintenance
P&ID	process and instrumentation diagram
psig	pound(s) per square inch gauge
RSP	raw sewage pump
SA	service air
scfm	standard cubic feet per minute
WPTP	West Point Treatment Plant

1. Background

1.1 Formulation Objective

The West Point Treatment Plant (WPTP) Instrument Air (IA) and Service Air (SA) project is an effort under King County's Project Formulation Program to develop the proposed project's scope, cost, and schedule to facilitate King County's future decision-making process on potential future improvements. King County (County) has identified the need to update the SA and IA compressors in the raw sewage pump (RSP) and oxygen generation and dissolution system (OGADS) buildings at WPTP because of issues related to the operation of existing systems and some equipment that is at or approaching the end of its service life. The primary objectives of this project are the following:

1. Investigate the feasibility of upgrading the IA/SA systems at the RSP and OGADS buildings.
2. Develop estimated costs for repairing leaking compressed air distribution piping throughout WPTP.
3. Assess the potential for reducing operating compressed air pressure; include possible impacts on equipment using compressed air.
4. Evaluate the need for backup power for the primary IA system at OGADS; include a power assessment of the plant's existing electrical service for accommodating potential changes.
5. Develop projected costs and associated implementation schedules for potential upgrade options.

There is a dedicated IA/SA system for solids handling equipment in the Solids Building that is not part of this scope of work. The RSP starting air system, cogeneration engines starting air system, chlorine building, breathing and instrument air systems, and the air unit processes of the HVAC system are not part of this scope of work.

1.2 Existing Air Systems

1.2.1 OGADS Air Systems

The OGADS IA system consists of four rotary screw air compressors, two receivers, two mist eliminators, three IA dryers, air demand controllers (IA and former SA), and valving. The compressors provide all IA to the plant distribution system, including the volume of IA needed to meet OGADS building demands. The compressors operate between 115 and 125 pounds per square inch gauge (psig), and the system can deliver up to 488 standard cubic feet per minute (scfm) (4 compressors) at 70 psig to the distribution system.

The OGADS compressed air system was originally installed in approximately July 1995 to provide IA for the oxygen generation system. The original system consisted of two rotary screw compressors, two desiccant air dryers, and two receivers. In July 2003, the system was expanded and in May 2006, the air system was further expanded and modified to generate both IA and SA, including the IA and SA needed for areas outside the OGADS building. Compressors #3 and #4 are approximately 17 and 13 years old, and thus within their expected rotary screw compressor service life of 30 years. Subsequent incidents with excessive SA use drew down the IA pressure to problematic levels for maintaining plant operations. IA is critical to the proper functioning of WPTP. Because the plant operates using bubbler level controls and relies on numerous pneumatically actuated valves, gates, and instruments, the decision was made in 2015 to separate SA and IA generation to avoid these problems. The air systems were modified to produce all plant IA at OGADS and all plant SA at RSP, with IA backup capability at RSP.

1.2.2 Raw Sewage Pump Air Systems

The RSP building has both SA and IA systems. The RSP IA systems consist of three reciprocating air compressors, two receivers, two IA dryers, aftercooler heat exchanger, and valving. The RSP SA systems consist of two reciprocating air compressors, two receivers, aftercooler heat exchanger, and valving. The compressors in the RSP building provide all SA to the plant distribution system. The IA system at RSP is available as a backup system to OGADS but is typically idled with air dryers being manually switched to periodically run each dryer unit. Occasionally, compressors are manually run. The compressors operate between 115 and 125 psig. Also, two former cogeneration air receivers, repurposed for engine starting air, were installed in 1995. The IA and SA systems at RSP are both tied into the plant air distribution systems (because the air distribution systems provided the original air supplies for the plant) and can be valved over to serve as backup systems for each other. Figure 1-1 shows a schematic of the WPTP compressed air system.

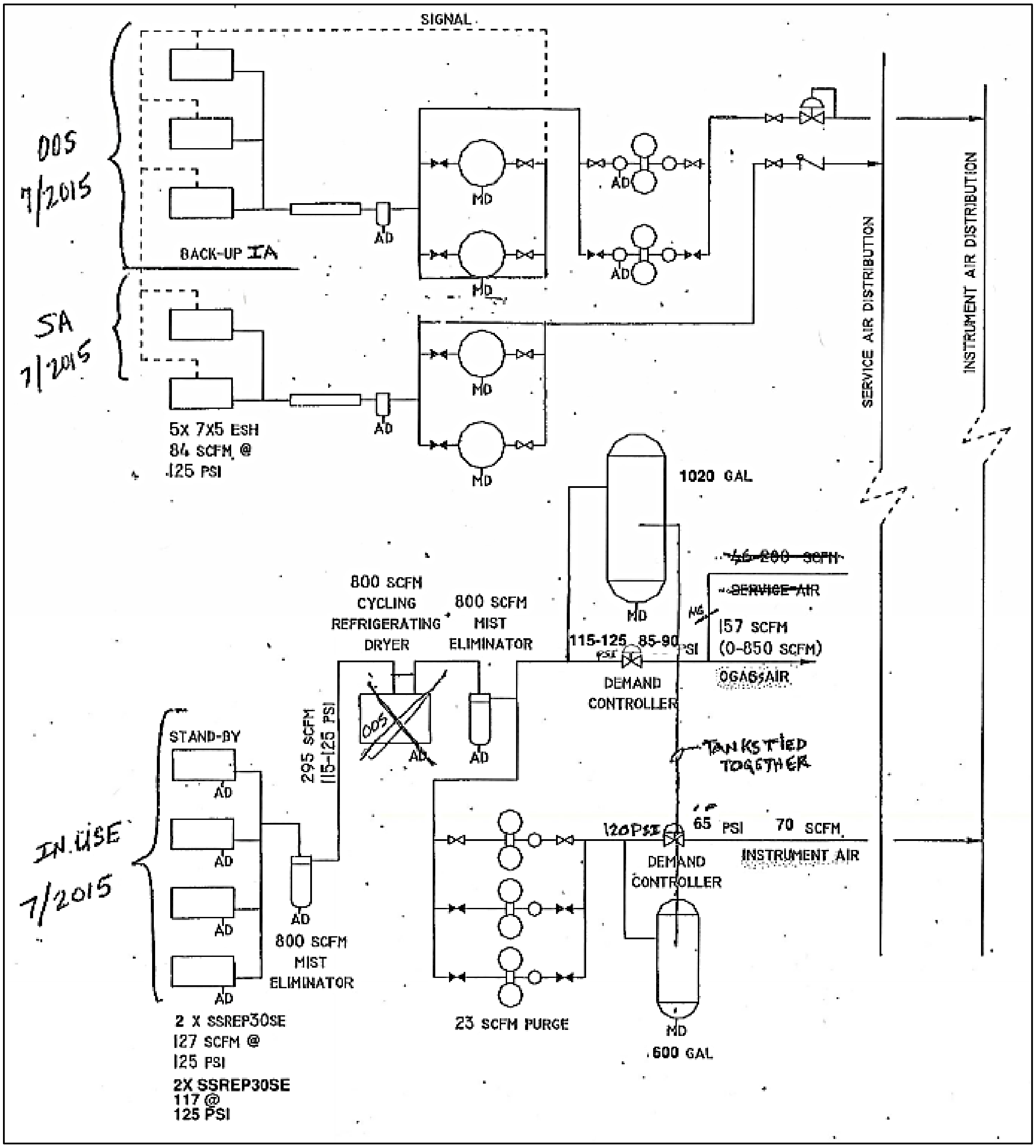


Figure 1-1. WPTP Compressed Air System Schematic

At RSP, the IA and SA reciprocating air compressors have been in service since 1995. The equipment is outdated and unreliable, and parts are increasingly difficult to obtain. Plant mechanics report that the two

IA dryer units at RSP are currently not functioning properly, and scheduled maintenance repairs were put on hold pending potential modification to the plant's compressed air system. The four IA and SA receivers have been in service since 1964 (as well as two starting air receivers from 1964 and two from 1995).

1.3 Audits and Operational Challenges

Compressed air system audits were conducted by Plant Air Technology in 2002 and by Compression Engineering Corporation/HDR in 2016. Both assessments identified potential improvements to the air systems. Several of these recommendations have been conducted; however, the following recommendations remain:

- Replace RSP reciprocating compressors with rotary screws (2016).
- Install two heated blower regenerative dryers for the OGADS IA system, to replace the three existing desiccant tower units, and eliminate refrigerated dryer (2016). Since then, the refrigerated dryer was removed and two heated blower dryer units were purchased in 2018.
- Provide both SA and IA from OGADS; WPTP had gone back to providing IA only at that time (2016).
- Reduce OGADS compressor pressure from 115 psig down to 95 psig (2016).
- Repair SA distribution piping leaks (2016).
- Replace drain valves with capacitance type for less maintenance (2016).
- Make other piping and component layout modifications (2016).
- Remove RSP compressors after satisfaction with OGADS system (2016).
- Open/bypass pressure controller to OGADS building demands (2016).

The recommended improvements from the two air audits were partially implemented over the years. Most of the 2002 audit recommendations were completed in 2006. Splitting the supply of SA and IA between RSP and OGADS, respectively, has provided stable pressures for meeting plant demands. The operations team has expressed the desire to keep operating the IA and SA systems separately for reliability but to retain backup capabilities associated with each facility.

During the 2016 audit, all SA and IA were being provided from OGADS, and the new air demand controllers were reset for lowered distribution pressures. Ultimately, the plant settled on maintaining SA pressure at 85 psig and IA pressure at 70 psig. Since the plant switched to supplying IA and SA from different sources, three OGADS compressors are reportedly handling all IA demands; however, there are concerns that the compressors' capacity is being maximized with little safety factor, should one compressor be offline for maintenance.

The plant has reverted to supplying plant SA from the RSP reciprocating compressors, which produce SA with minimal moisture removal. Staff feedback is inconsistent as to how significant an issue water contamination is in the SA system; however, both air audits raised water contamination as a concern.

Adsorber room temperatures were normal prior to addition of two newer air compressors. The air compressors in the OGADS building contribute significant heat to the Adsorber Room. Compressor coolant radiators release heat directly into the adsorber room. The radiator discharge temperature has been reported to be 108 degrees. High room temperatures result in higher compressor supply air temperatures, higher moisture saturation, and an uncomfortable work environment. This situation can lead to higher energy consumption and operational inefficiencies as the equipment attempts to compress and dry the air to system pressure dew point requirements.

The Engine Room at RSP is congested with equipment. Given the potential need for additional space for the Raw Sewage Pumps Upgrade project (to replace the engines with motors) and the desire to move equipment above ground, the RSP IA and SA systems may benefit from being relocated to a different building.

Table 1-1 summarizes the compressed air equipment and potential items for consideration during project formulation.

Table 1-1. WPTP Compressed Air Equipment Items for Consideration

Location	System/Equipment	Item for Consideration
OGADS	IA Compressors	• Two units nearing end of useful service life • Two units at approximately half of their useful service life. Compressor #4 has had multiple maintenance issues.
	IA Dryers	• Two units at end of useful service life and one unit nearing end of useful service life • Two heated blower dryers purchased to save energy by replacing these three dryers
	General	• High temperatures in building • Hearing protection required in area
	IA System Power	• Backup power evaluation requested
RSP	SA Compressors	• Not functioning properly • Nearing end of service life • Challenging to find parts
	IA Compressors	• Not functioning properly • Nearing end of service life • Challenging to find parts
	IA Dryers	• Past end of useful service life • Not functioning properly • Needs major maintenance repairs
	SA Distribution	• Water contamination in supplied SA
Plant-wide	IA and SA distribution piping	• Air leaks

2. Instrument Air and Service Air Upgrade Options

2.1 Options Criteria

This technical memorandum presents conceptual design options and involves a qualitative evaluation to identify viable options and develop preliminary order of magnitude cost estimates for each option. The options are evaluated based on the following criteria:

1. Efficiency and reliability of IA/SA system operation
2. Access during construction and operations and maintenance (O&M)
3. Impact on plant operations during modifications
4. Safety
5. Energy efficiency
6. Process resiliency benefit

2.2 Improvements at OGADS

This section provides a discussion of the proposed improvements at OGADS, including replacement of the compressors, installation of two heated blower desiccant dryers, installation of the refrigerated dryer for SA, and the relocation of the IA/SA systems from OGADS. See Table 2-4 at the end of this section for a summary of this analysis.

Currently plant IA is supplied from OGADS and SA from RSP. The following options evaluation assumes that this setup will be maintained during modifications. Other configurations (e.g. having OGADS serve all plant IA and SA demands) can be investigated during alternatives analysis.

2.2.1 Replace Compressors

The average capacity of the existing OGADS compressors is 122 cubic feet per minute (cfm) at 125 psig. Replacement compressor models with slightly greater capacity for the same horsepower are available (see examples in Table 2-1). The existing compressors Nos. 1 and 2 have been in nearly continuous operation since 1995, which puts them at almost 25 years into their service life. The County considers standard useful service life for rotary screw compressors to be 30 years. Therefore, the County should consider replacing these compressors during the next 5 years. Compressor No. 3 is almost 17 years old, and Compressor No. 4 is almost 14 years old, so they should have adequate useful life remaining, but maintenance issues should be taken into consideration (e.g., Compressor No. 4 has reportedly exhibited some serviceability problems).

Table 2-1. OGADS Compressors, Existing and Available Options

Existing Equipment	Manufacturer and Model	Capacity	Available Compressors	Capacity
Instrument Air Compressor Nos. 1 and 2	Ingersoll-Rand SSR-EP30SE	117 cfm, 30 hp	Ingersoll-Rand RS22i, 30 hp	124 cfm at 125 psig
Instrument Air Compressor Nos. 3 and 4	Ingersoll-Rand SSR-EP30SE	127 cfm, 30 hp	Kaeser ASD 30, 30 hp	132 cfm at 125 psig

Note: hp = horsepower

2.2.1.1 Efficient and Reliable IA/SA System Operations

Replacing the compressors at OGADS would provide new and mechanically reliable equipment. Two of the existing compressors would be replaced with the same type of compressor that WPTP staff are familiar with and prefer over reciprocating compressors. Rotary screw compressors are more efficient than reciprocating compressors because rotary screw compressors provide more capacity (cfm) for the horsepower used.

2.2.1.2 Safe Access during Eventual Construction and O&M

The two example replacement compressors are comparable in physical size to the existing compressors, with the Ingersoll-Rand model having a 20 percent smaller footprint and the Kaeser model being narrower. The existing maintenance access area around the equipment appears to be marginally adequate and can be maintained during construction and for O&M of new compressors.

2.2.1.3 Impact of Refurbishment to the Plant

Minimal impact on plant operations is anticipated from replacing compressors. It is assumed that the new compressor units will be placed in generally the same spaces where the current compressors are located, but with opportunities for improved configuration (see Appendices for proposed OGADS layout). During construction, the compressors can be replaced one at a time so that full duty capacity (i.e., three out of four compressors in service) is maintained. As needed during construction, a portable air compressor could be used to provide some backup capacity via the existing external connection at the exterior wall of the OGADS building.

2.2.1.4 Safety Concerns

During system improvements, the plant would maintain the safety systems that are currently in place.

2.2.1.5 Potential Energy Efficiency Improvements

The existing compressors would be replaced by new rotary screw compressors that potentially have slightly greater capacity for a machine of the same horsepower. Slight increases in energy efficiency would also be expected from increased output with the use of new machinery, which would have reduced internal losses. There is the potential to address high room temperatures and improve energy efficiency by relocating the air compressor systems to a different building (see section 2.2.4) or repairing the OGADS return air damper system to reject the excessive heat outside of the building (see section 2.2.5).

2.2.1.6 Resiliency Benefits

The installation of new compressors would provide a more reliable and resilient operation, compared to relying on machines that are approaching the end of their service life, which would entail increasing levels of maintenance. The configuration at OGADS relies on up to three duty compressors with one standby compressor for taking units out of service for maintenance. Other options for providing greater capacity and/or more redundancy would likely require relocating the compressed air system and/or upgrading the power supply.

2.2.2 Install Heated Blower Desiccant Dryers

The three existing regenerative desiccant dryers would be replaced by two heated blower desiccant dryers, which have already been purchased by the County. The new heated blower dryer is physically larger than the three desiccant tower units, so some adjusting of the layout would be required. The existing dryers Nos. 1 and 2 have been in nearly continuous operation since 1995, which puts them almost 25 years into their service life. Dryer No. 3 has been in operation since 2006, so it has more service life remaining. The County considers standard useful service life for dryers to be 25 years. Therefore, replacing at least the two older dryers is in line with end of service life considerations.

2.2.2.1 Efficient and Reliable IA/SA System Operations

Replacing the dryers at OGADS would provide new and mechanically reliable equipment. Additionally, each new unit has a larger capacity of 500 cfm (a total of 1,000 cfm) compared to the existing dryers, which are 150 cfm each (a total of 450 cfm). The new system also includes a pre-filter and after-filter to protect the desiccant from oil contamination.

2.2.2.2 Safe Access during Eventual Construction and O&M

The footprint of each of the purchased replacement dryers (57 by 48 inches) is about two times the total footprint of the current dryers (24 by 24 inches each). Thus, this replacement will most likely require reconfiguring the current space. The existing maintenance access around the equipment appears to be marginally adequate, so removing the three dryers and adjusting the configuration could benefit maintenance access.

2.2.2.3 Impact of Refurbishment to the Plant

To minimize potential impacts on plant operations during construction, the plant could install one of the new dryers while existing dryers remain in service so that drying capacity is maintained. It is assumed that there is adequate space for the new heated blower dryers and four new compressors in the existing space. Space configuration can be investigated further during detailed design.

2.2.2.4 Safety Concerns

During system improvements, the plant would maintain the safety systems that are currently in place.

2.2.2.5 Potential Energy Efficiency Improvements

The three existing dryers purge constantly while regenerating one tower each of spent desiccant resin. This results in the estimated loss of 51 scfm of compressed air or about 40 percent of one compressor’s output, which represents approximately 15 percent of compressor system power. The new heated blower desiccant dryers do not use high-pressure compressed air to regenerate the desiccant resin. They use heated ambient air at a much lower pressure and, thus, are expected to perform more energy efficiently than the existing dryers. The new dryers come with the option of controlling the heater and/or blower by the outlet regeneration temperature and shutting off to save electrical power once the desiccant has been thoroughly regenerated, reducing energy costs even further.

2.2.2.6 Resiliency Benefits

The installation of the new dryer system would provide a more reliable and resilient operation, compared to relying on machines that are at the end of their useful service life, which would entail increasing levels of maintenance.

This installation involves replacing three dryer units with two. However, each of the new units has a larger capacity than all the old units combined. Drying needs can be met with one dryer offline. Thus, two new units provide added capacity, redundancy, and resiliency.

Since the heated blower dryer uses ambient pressure air, it eliminates problems with bleeding down compressed air pressure from the system. The upgraded dryer control system should be investigated in more detail for addressing dryer failure alarming.

2.2.3 Install Refrigerated Dryer for Service Air

In consideration of possibly providing all plant IA and all SA from OGADS, providing for a minimum level of air drying for SA would be beneficial for addressing water contamination in the SA distribution system. A new refrigerated dryer could be added downstream of the first 500 scfm mist eliminator and would provide a first stage of moisture removal for all compressed air. This would reduce the water load on the desiccant dryer and energy required for that second stage of drying (for IA only). Additional modifications to the piping and valve configuration would be required to convey SA and IA to the appropriate locations of demand. It is highly recommended that this option include installation of an automated “safety shutoff” valve on the SA distribution supply that would close upon activation of a low air pressure alarm. This valve would prevent plant IA pressure from being drawn down to problematic levels as has occurred in the past.

2.2.3.1 Efficient and Reliable IA/SA System Operations

Installing a refrigerated dryer at OGADS for plant SA supply would allow for consolidation of all air compressors and drying at one location. A new dryer would provide a minimum level of air drying for SA that does not currently exist, which would eliminate identified problems in the SA system. Refrigerated dryers are reportedly more energy efficient than desiccant dryers because they only achieve +40 degree F dew point air versus -40 degree F dew point air for desiccant dryers. By providing all plant air from OGADS, the backup air systems at RSP could potentially be eliminated, thus reducing maintenance effort and costs.

2.2.3.2 Safe Access during Eventual Construction and O&M

The existing maintenance access area around the equipment appears to be marginally adequate and would be maintained during construction. Adding a new refrigerated dryer would likely require reconfiguration of the space, which would afford an opportunity to design for improved maintenance clearance. It is assumed this new refrigerated dryer will be in the general space where the old refrigerated dryer was formerly located. Space configuration can be investigated further during detailed design.

2.2.3.3 Impact of Refurbishment to the Plant

For construction, this option could install the new refrigerated dryer while the existing IA dryers remain in service, so that drying capacity is maintained. The piping could also be reconfigured so that compressors can be connected to the refrigerated dryer and the desiccant dryer, either in parallel (i.e., ensuring the option of entirely separating the IA and SA systems) or in series to provide two stages of air drying.

2.2.3.4 Safety Concerns

During system improvements, the plant would maintain the safety systems that are currently in place.

2.2.3.5 Potential Energy Efficiency Improvements

Adding a dedicated refrigerated dryer for SA would reduce the load on the IA desiccant dryers, which are currently being used for all compressed air coming from the OGADS building.

2.2.3.6 Resiliency Benefits

The installation of a new dryer system for SA would give WPTP the option of supplying all plant IA and SA from the OGADS building and relying on the RSP compressed air systems as backup to provide the greatest level of resiliency.

2.2.4 Relocate Instrument Air/Service Air Systems from OGADS

Another option for OGADS improvements is to relocate the compressed air system to a different building. Relocating the IA/SA system would lower temperatures in the OGADS building, improving worker comfort during maintenance, and free up space in the existing location. Certain locations, such as the chlorine building, were identified as possibly being available at the time of this study. However, the future project team will evaluate and make their own decisions regarding a specific location.

2.2.4.1 Efficient and Reliable IA/SA System Operations

The installation of new compressors and dryers would provide a more efficient and reliable operation, compared to relying on machines that are at or approaching the end of their service life, which entails increasing levels of maintenance. A new compressed air system can be designed to meet current standards and to address existing issues regarding heat generation and maintenance access. Operating compressors in a space with lower air temperatures would also be more efficient given the reduced power requirement compared to compressing higher temperature air. The new IA/SA system could also be designed with adequate redundant or backup capacity to allow for eliminating the RSP compressed air systems with commensurate cost savings for maintaining air systems in one location.

2.2.4.2 Safe Access during Eventual Construction and O&M

The equipment could be laid out in a new area to provide improved operation access and greater maintenance clearance.

2.2.4.3 Impact of Refurbishment to the Plant

Relocating new compressors would allow for the system to be constructed at a different location while the OGADS air systems are kept online, so operations would not be affected and the current supply of IA to the plant would not be interrupted. This would also eliminate high temperature issues in the OGADS building and the need for reconfiguring the piping layout.

2.2.4.4 Safety Concerns

The new compressed air system would maintain comparable safety systems to those currently in place.

2.2.4.5 Potential Energy Efficiency Improvements

Currently, large portable fans are used intermittently at the OGADS building to address the building’s heat issue. Relocating the IA system would reduce excess energy consumption used for machine cooling and for compressing higher temperature air. Regarding the air compressor replacement option, installing new compressors affords improved efficiency through the use of brand new equipment built to contemporary standards.

2.2.4.6 Resiliency Benefits

The installation of new compressors and dryers would provide a more resilient operation compared to relying on machines that are approaching the end of their service life. A new system can be designed with more robust backup capacity to more easily handle outage situations.

2.2.5 Other Modifications/Work Items at OGADS

2.2.5.1 Repair/Modify HVAC system

This option can potentially address high temperature issues inside the OGADS building. The VSAs require feed air at 96-98 degrees and as such, the return air damper system at OGADS is constructed such that warm air from the building can either be routed outside or used as VSA feed air in cooler months. This damper system was originally intended to be automatically controlled based on air temperature. However, due to recurring problems with the damper system, it is currently controlled manually. This option would repair the automatic damper system so that high temperature air would be directed outside the building when not needed for VSA feed air, which should help reduce air temperatures in the Adsorber Room.

Alternatively, another option was provided to extend return air ducting to better capture high temperature “cooling” air discharged by the compressors. As proposed, the return air ducting would be extended to intakes in the vicinity of each of the four compressors to convey the hot air outside the building.

2.2.5.2 Reconfigure piping

Given plant staff’s preference for a more logical compressed air system piping layout, a line item for this is included in this analysis. An improved layout would group compressors together and dryers together followed by receivers in process sequence with generous clearances provided for maintenance access.

2.3 Improvements at Raw Sewage Pump

This section provides a discussion of the proposed improvements at RSP, including replacement of the compressors, installation of the refrigerated dryer for SA, replacement of the IA compressors, replacement of the IA dryers, and the relocation of the IA/SA systems from RSP to another building. See Table 2-4 at the end of this section for a summary of this analysis.

2.3.1 Replace Service Air Compressors

This option involves replacing the two existing reciprocating SA compressors with rotary screw compressors. Table 2-2 provides a summary of the replacement RSP SA compressors.

Table 2-2. Replacement RSP SA Compressors

Existing Equipment	Manufacturer and Model	Capacity	Available Compressors	Capacity
Service Air Compressors Nos. 1 and 2	Ingersoll-Rand Model ESH	88 cfm at 125 psig, 25 hp	Ingersoll-Rand RS18i, 25 hp	107 cfm at 125 psig
			Kaeser ASD 25, 25 hp	122 cfm at 125 psig

2.3.1.1 Efficient and Reliable IA/SA System Operations

The SA compressors at RSP require high levels of maintenance because of age. The maintenance team is unable to find parts when the compressors need repairs. Replacing the SA compressors at RSP would provide new and mechanically reliable equipment. The existing reciprocating compressors would be replaced with rotary screw compressors that WPTP staff are familiar with and prefer. Rotary screw compressors are generally more efficient than reciprocating compressors because they provide more capacity (cfm) for the horsepower used.

2.3.1.2 Safe Access during Eventual Construction and O&M

The two example replacement compressors are physically smaller than the existing compressors, with the Ingersoll-Rand model having a 60 percent smaller footprint. The existing maintenance access around the equipment appears to be marginally adequate and would be improved with the installation of new, smaller compressors.

2.3.1.3 Impact of Refurbishment to the Plant

Currently, all plant SA is provided from RSP. It is assumed that the new compressors will be in the spaces where the current compressors are (see Appendices for proposed RSP layout). For minimal impacts on plant operation during construction, the compressors can be replaced one at a time, so that some SA capacity is always maintained, and/or existing IA compressors could be valved in for use as SA backup. This analysis also included provisions for a portable backup air compressor to be piped into the SA system at RSP.

2.3.1.4 Safety Concerns

During system improvements, the plant would maintain the safety systems currently in place or install comparable safety systems with new improvements.

2.3.1.5 Potential Energy Efficiency Improvements

The existing compressors would be replaced by new rotary screw compressors that are shown to have greater capacity for machines with the same horsepower. Slight increases in energy efficiency would also be expected because of increased output with the use of new machinery, which would have fewer internal losses.

2.3.1.6 Resiliency Benefits

The installation of new compressors would provide a more reliable and resilient operation, compared to relying on machines that are approaching the end of their service life, which would entail increasing levels of maintenance.

2.3.2 Install Refrigerated Dryer for Service Air

A new refrigerated dryer can be added downstream of the SA compressors to provide a minimum level of air drying and eliminate any issues with water contamination in the SA distribution system. Refrigerated dryers produce air at +40 degrees F dew point, which is adequate for most SA applications. Desiccant dryers produce air that is much dryer (-40 degrees F dew point) than typically needed for SA and are more expensive to operate and maintain. Any SA piping that is routed outdoors would still need to be protected from condensing and/or freezing conditions for when temperatures drop below +40 degrees F.

2.3.2.1 Efficient and Reliable SA System Operations

Adding a new refrigerated dryer would provide new and mechanically reliable equipment. Providing a minimum level of drying would eliminate problems with water contamination in the distribution system.

2.3.2.2 Safe Access during Eventual Construction and O&M

The existing maintenance access around the RSP compressed air equipment appears to be adequate, although minimally so. Adding a new refrigerated dryer would likely require reconfiguration of the space and would depend on the outcome of RSP upgrade decision making.

2.3.2.3 Impact of Refurbishment to the Plant

Currently, all plant SA is provided from RSP without using dryers. Assuming that adequate space can be devoted to installing the new dryer, the installation work can be done offline and the dryer valved in when ready, with no impacts on plant operations.

2.3.2.4 Safety Concerns

During system improvements, the plant would maintain the safety systems that are currently in place, and new construction would include installation of comparable new safety systems.

2.3.2.5 Potential Energy Efficiency Improvements

Adding a dedicated refrigerated dryer for SA would result in a slight increase in energy consumption but with the documented benefits. Compared to desiccant dryers, refrigerated dryers would provide a more energy efficient means of producing dry air at SA quality.

2.3.2.6 Resiliency Benefits

The installation of the refrigerated dryer would provide higher quality SA and eliminate issues with water contamination in the distribution system, such as freezing of outdoor lines and internal corrosion of iron and steel piping. This would reduce process unit shutdowns and maintenance, thus improving resiliency.

2.3.3 Replace Instrument Air Compressors at Raw Sewage Pump

This option involves replacing the three existing reciprocating IA compressors with rotary screw compressors. OGADS currently supplies all IA for WPTP, but plant staff wish to consider maintaining backup IA capacity elsewhere at the plant. Table 2-3 provides a summary of the replacement RSP IA compressors.

Table 2-3. Replacement RSP IA Compressors

Existing Equipment	Manufacturer and Model	Capacity	Available compressors	Capacity
Instrument Air Compressors Nos. 1, 2, and 3	Ingersoll-Rand Model ESH	88 cfm at 125 psig, 25 hp	Ingersoll-Rand RS18i, 25 hp	107 cfm at 125 psig
			Kaeser ASD 25, 25 hp	122 cfm at 125 psig

2.3.3.1 Efficient and Reliable IA/SA System Operations

The IA compressors at RSP require high levels of maintenance because of age. The maintenance team is unable to find parts when the compressors need repairs. Replacing the IA compressors at RSP would provide new and mechanically reliable equipment. The existing compressors would be replaced with the same type of compressor that is used in other areas of the plant. Rotary screw compressors are more efficient than reciprocating compressors because rotary screw compressors provide more capacity (cfm) for horsepower used.

2.3.3.2 Safe Access during Eventual Construction and O&M

The two example replacement compressors are smaller than the existing compressors, with the Ingersoll-Rand model having a 60 percent smaller footprint. The existing maintenance access around the equipment appears to be marginally adequate and can be maintained during construction. New smaller compressors should provide improved maintenance access clearance.

2.3.3.3 Impact of Refurbishment to the Plant

It is assumed the new IA compressors will be located in the general space where the old IA compressors are currently located. The RSP IA compressors are currently configured as backup for the OGADS IA system but are rarely used. Therefore, taking these compressors out of service for installation of new compressors is not anticipated to have any significant impact on plant operations. Another option would be to replace these one at a time so that some IA backup capacity is maintained during construction. This analysis also included provisions for a portable backup air compressor to be piped into the IA system at RSP.

2.3.3.4 Safety Concerns

During system improvements, the plant would maintain the safety systems that are currently in place, and new construction would provide comparable new safety systems.

2.3.3.5 Potential Energy Efficiency Improvements

The existing compressors would be replaced by new rotary screw compressors that are shown to have greater capacity for the same hp machine. Increased energy efficiency would also be expected because of increased output with the use of new machinery, which would have fewer internal losses.

Currently, the average capacity of the RSP IA compressors is 88 cfm at 125 psig. It is possible to replace these with compressors of greater capacity for the same power input (see Table 2-3).

2.3.3.6 Resiliency Benefits

Replacing the IA compressors would ensure that a backup is available for the main IA system at OGADS, thus providing added resiliency. Given the adequate existing redundancy at OGADS, there is currently less priority for providing IA capacity at RSP.

2.3.4 Replace Instrument Air Dryers

The two existing desiccant dryers currently have functional issues. They were installed in 1989, which puts them beyond their useful service life of 25 years. Replacing the IA desiccant dryers is only required if backup IA service is maintained at RSP.

2.3.4.1 Efficient and Reliable IA/SA System Operations

Replacing the IA dryers at RSP would provide new and mechanically reliable equipment.

2.3.4.2 Safe Access during Eventual Construction and O&M

The existing maintenance access around the equipment appears to be marginally adequate and would be maintained during construction. Installation of new dryers should be designed to improve upon maintenance clearance as feasible.

2.3.4.3 Impact of Refurbishment to the Plant

Given that the RSP IA system serves strictly as a backup system to OGADS, there should be minimal to no impacts on plant operations with installation of new dryers. In addition, given the current problems with the existing IA dryer performance, installation of new, properly functioning equipment could be accomplished without significant loss of capacity.

2.3.4.4 Safety Concerns

During system improvements, the plant would maintain the safety systems that are currently in place, and new construction would provide comparable new safety systems.

2.3.4.5 Potential Energy Efficiency Improvements

Properly functioning dryers would result in less air loss through leaks, which should increase energy efficiency. If the heated blower dryer option were implemented, energy improvements would be gained by eliminating the 15 percent power consumption lost for purge air.

2.3.4.6 Resiliency Benefits

Installation of new dryers at RSP would restore properly functioning backup IA capacity for OGADS.

2.3.5 Relocate Instrument Air/Service Air Systems from Raw Sewage Pump

Relocating the RSP IA and SA systems to a different location has a few potential benefits. The RSP Replacement project could affect process areas adjoining the raw sewage pumps and may consume additional space in the existing Engine Room where the compressed air equipment is currently located. Relocating the compressed air systems would eliminate potential space conflicts. In addition, moving equipment to an at-grade location would minimize the potential for flooding risks. While this project formulation will not identify where the systems could be relocated, Sections 2.3.5.1 through 2.3.5.6 provide the pros and cons of IA/SA relocation from RSP.

2.3.5.1 Efficient and Reliable IA/SA System Operations

As for the other RSP compressor options, the IA and SA compressors at RSP require high levels of maintenance because of age. The maintenance team is unable to find parts when the compressors need repairs. Replacing the compressors would provide new and mechanically reliable equipment. The existing compressors would be replaced with the same type of compressor that staff are familiar with and prefer. Rotary screw compressors are more efficient than reciprocating compressors because rotary screw compressors provide more capacity (cfm) for the horsepower used.

2.3.5.2 Safe Access during Eventual Construction and O&M

The equipment layout could be designed with more generous provisions for access and maintenance clearances in a new location.

2.3.5.3 Impact of Refurbishment to the Plant

Installing new compressors at a different location to free up space at RSP could be done while existing RSP air systems are kept online and would not affect operations or the existing supply of SA to the plant.

2.3.5.4 Safety Concerns

During system improvements, the plant would maintain the safety systems that are currently in place, and new construction would provide comparable new safety systems.

2.3.5.5 Potential Energy Efficiency Improvements

The existing compressors would be replaced by new rotary screw compressors that are shown to have greater air generation capacity per unit of power consumed. Slight increases in energy efficiency would also be expected because of increased output with the use of new machinery, which would have fewer internal losses.

2.3.5.6 Resiliency Benefits

The installation of new compressors and dryers would provide a more reliable and resilient operation, compared to relying on machines that are approaching the end of their service life, which would entail increasing levels of maintenance.

The engine room floor where the IA/SA systems are currently located was subject to flooding in 2017. Placing compressors at a higher elevation would provide additional protection from flooding and thus improve resiliency

Table 2-4. Instrument Air and Service Air Upgrade Options Table

	Efficient and Reliable IA/SA system operation	Safe Access During Construction and O&M	Avoids Impacts on plant operations	Addresses Safety Concerns	Potential Energy Efficiency Improvements	Resiliency benefits
Improvements at OGADS						
Replace Compressors	New compressors will improve efficiency and reliability	• Comparable in size. • Existing area marginally adequate.	• Full duty (3 of 4) compressors can be maintained during construction • Additional temporary system can be used as needed during construction	Expect all safety systems maintained during construction	• Greater capacity for the same horsepower. • Increased efficiency expected from new machines	New compressors improve reliability and resiliency
Install Heated Blower Desiccant Dryers	• New dryers will add to reliability • Increased dryer capacity	• Larger footprint than existing • Most likely requires reconfiguration of current space	• Install one at a time to maintain drying capacity	Expect all safety systems maintained during construction	New dryers use heated ambient air instead of compressed air; increased efficiency expected	New dryers improve reliability, resiliency, and drying capacity
Install Refrigerated Dryer for Service Air	New refrigerated dryer will add to reliability	• Existing area marginally adequate • Most likely requires reconfiguration of current space	Existing drying capacity can be maintained during construction	Expect all safety systems maintained during construction	Reduces load on IA desiccant dryers	Provides option of supplying IA and SA from OGADS, with RSP as backup
Relocate Instrument Air/Service Air Systems from OGADS	System relocation will add to reliability	Equipment could be laid out for improved access and clearance	• Operations likely would not be affected • Eliminates high temperature issue at OGADS	Expect all safety systems maintained during construction	• Reduces excess energy used for cooling • Increased efficiency expected from new machines	Relocated system improves reliability and resiliency
Improvements at RSP						
Replace Service Air Compressors	New compressors will add to reliability	• Some options are smaller in size than existing • Existing area marginally adequate	There are options to maintain capacity during construction	Expect all safety systems maintained during construction	• Greater capacity for the same horsepower. • Increased efficiency expected from new machines	New compressors improve reliability and resiliency
Install Refrigerated Dryer for Service Air	New refrigerated dryer will add to reliability	• Existing area minimally adequate • Likely to require space reconfiguration	No impacts expected, assuming adequate space available for new dryer	Expect all safety systems maintained during construction	• Slight increase in energy consumption • More energy efficient compared to desiccant dryers	Higher quality SA addresses issues resulting from SA water contamination
Replace Instrument Air Compressors at Raw Sewage Pump	New compressors will add to reliability	• Some options are smaller in size than existing • Existing area marginally adequate	• Minimal impact expected • Option to replace one at a time to maintain backup IA capacity	Expect all safety systems maintained during construction	• Greater capacity for the same horsepower. • Increased efficiency expected from new machines	Reduces process unit shutdowns and maintenance
Replace Instrument Air Dryers	New dryers will add to reliability	Existing area marginally adequate	Minimal to no impacts expected	Expect all safety systems maintained during construction	• Increased energy efficiency • Added energy improvements if heater blower type used	• Ensures backup is available for IA at OGADS. Improves resiliency • Given adequate existing redundancy at OGADS, less priority for providing IA capacity at RSP
Relocate Instrument Air/Service Air Systems from RSP	System relocation will add to reliability	Equipment could be laid out for improved access and clearance	Operations likely would not be affected	Expect all safety systems maintained during construction	• Greater capacity for the same horsepower. • Increased efficiency expected from new machines	• Improves reliability and resiliency • Relocation to higher elevation provides additional flood protection

3. Other General Modifications

In addition to IA/SA system replacement, the County has requested that other miscellaneous items be replaced, upgraded, or evaluated. The scope of work associated with those items and used in the cost estimate and basis of estimate are documented in this section.

3.1 Leaking Compressed Air Piping

The WPTP team identified pipe joints and particularly grooved-end couplings as the major source of leaks in compressed air piping throughout the plant. This option focuses on upgrading the grooved-end (GE) joints in the SA and IA distribution piping. The GE joints of concern are 3 inches and 4 inches in diameter. Many of these couplings are 25 years old or older, and the elastomeric gaskets are likely very aged and dried out. This option replaces the gaskets, which a Victaulic representative agreed would be a reasonable course of action. Another design consideration is to add more isolation valves to help with gasket change work and for future maintenance.

3.2 Assessment of Potential for Reducing Operating Compressed Air Pressure

The operating IA and SA distribution system pressures had previously been reduced to 70 psig and 85 psig, respectively, as a follow up to the 2002 and 2016 compressed air audits. However, plant O&M staff currently consider SA distribution pressure to be too low in some instances to effectively operate pneumatic tools and devices (e.g., gate operators) remotely around the plant. IA distribution pressure reportedly is adequate at the current setpoint. Based on this input, no further consideration was given to further reducing distribution system pressures.

Regarding possibly lowering compressor operating pressures upstream of the air demand controllers (pressure control valves), plant and engineering staff expressed concerns that lowering compressor operating pressures could lead to operational problems. These compressors operate at a much higher pressure (115 to 125 psig) than the demands require as is typical for compressed air systems, and higher-pressure air is stored in a receiver to provide a reserve for large and/or lengthy peak air demands in the system. If operated at a lower pressure, the compressors would likely have to run more frequently or for longer periods to catch up to demands, which would not be beneficial for energy savings or plant operations. This analysis concluded that lowering compressor operating pressures would not be beneficial.

The next phase of this project would benefit from developing a comprehensive inventory of the plant’s compressed air demands including device pressure/volume/flow requirements and compressed air quality required. This information would be helpful for decision making regarding ultimate compressed air capacity needed for meeting plant demands.

3.3 OGADS Air System Backup Power Evaluation

The power supply to the four OGADS air compressors is already configured to be fed with two compressors on power Bus A and two compressors on power Bus B. No action is required regarding providing backup power to the compressors. The design of the heated blower dryers installation should similarly incorporate power supplies from separate buses to the two new dryers.

4. Summary

This section provides a summary of the options considered at each facility and other considerations that have potential benefit. The Cost Estimate, Basis of Estimate, and Cost-loaded Schedule will be provided as separate deliverables.

4.1 OGADS

4.1.1 Upgrades at OGADS

- Replace two older compressors over the next 5 years. (Section 2.2.1)
  - The two older rotary screw compressors are nearing the end of their useful service life. The two slightly newer compressors can be replaced in turn as they approach the end of their service life and/or as warranted by service conditions. At a minimum, these compressors can be replaced one at a time to ensure adequate IA capacity into the future.
- Remove existing air dryers and install new heated blower dryers. (Section 2.2.2)
  - The County has already invested in the heated blower desiccant dryers as an energy savings project. These units should be installed as planned.

Advantages

- Utilize existing space and infrastructure
- Upgrade to new equipment manufactured to contemporary standards
- Save energy and reduce risk associated with desiccant dryer malfunctions

Disadvantages

- Making changes in current space with existing equipment may increase complexity of upgrades
- Space and configuration constraints
- Does not address heat problem

4.1.2 Relocate IA/SA systems from OGADS (Section 2.2.4)

- Install new heated blower dryers.
  - The County has already invested in the heated blower desiccant dryers as an energy savings project. These units should be installed as planned.
- Install new compressors
  - New compressors can be installed at a new location designed to accommodate all equipment in a logical configuration with proper clearances.

Advantages

- Relocating the air systems from OGADS would allow it to be constructed offline without affecting the existing IA supply.
- New space may provide the possibility of having more equipment configuration options.
- Possibility to have less noise and lower air temperatures in a space designed to handle all equipment impacts.
- Major heat source is removed from the OGADS Building

Disadvantages

- Requires possible seismic or building upgrades at new location

- Requires entirely new equipment and infrastructure (besides the heated blower dryers already purchased)

4.2 Raw Sewage Pump Building

4.2.1 Upgrades at RSP

- Install new SA compressors and refrigerated dryer at RSP (Sections 2.3.1 and 2.3.2)
  - The existing compressors are not reliable and need to be replaced if SA is to be provided from RSP. A refrigerated dryer would provide the minimum level of air drying for SA.
- Install new IA compressors and heated blower dryers at RSP.
  - The existing compressors are not reliable and need to be replaced if IA is to be provided from RSP. New heated blower dryers would provide a more energy efficient means of getting to IA quality.

Advantages

- Utilize existing space and infrastructure
- Upgrade to new equipment manufactured to contemporary standards
- Save energy and reduce risk associated with desiccant dryer malfunctions
- Prevent piping corrosion and water contamination problems in the SA distribution system.

Disadvantages

- Making changes in current space with existing equipment may increase complexity of upgrades
- Space and configuration constraints

4.2.2 Relocate IA/SA air system from RSP (Section 2.3.5)

- Install new SA compressors and refrigerated dryer at new location
  - Relocating the SA system from RSP would allow it to be constructed offline without affecting the existing SA supply. If possible, it should be constructed at a lower risk location.
- Install new IA compressors and dryer at new location.
  - Relocating the IA system from RSP would allow it to be constructed offline without affecting the existing IA backup supply. If possible, it should be constructed at a lower risk location.

Advantages

- Relocating the air systems from RSP would allow it to be constructed offline without affecting the existing IA backup supply.
- New space may provide the possibility of having more equipment configuration options.
- Relocation frees up space in the RSP Engine Room

Disadvantages

- Requires possible seismic or building upgrades at new location
- Requires entirely new equipment and infrastructure

4.3 Other Considerations

- Install automated SA safety shutoff valve to safeguard the plant's air supply while supplying both plant IA and SA from OGADS.
- Install refrigerated dryer for supplying SA from OGADS (Section 2.2.3). This will address SA moisture contamination issues and reduce water load on other dryers in OGADS.

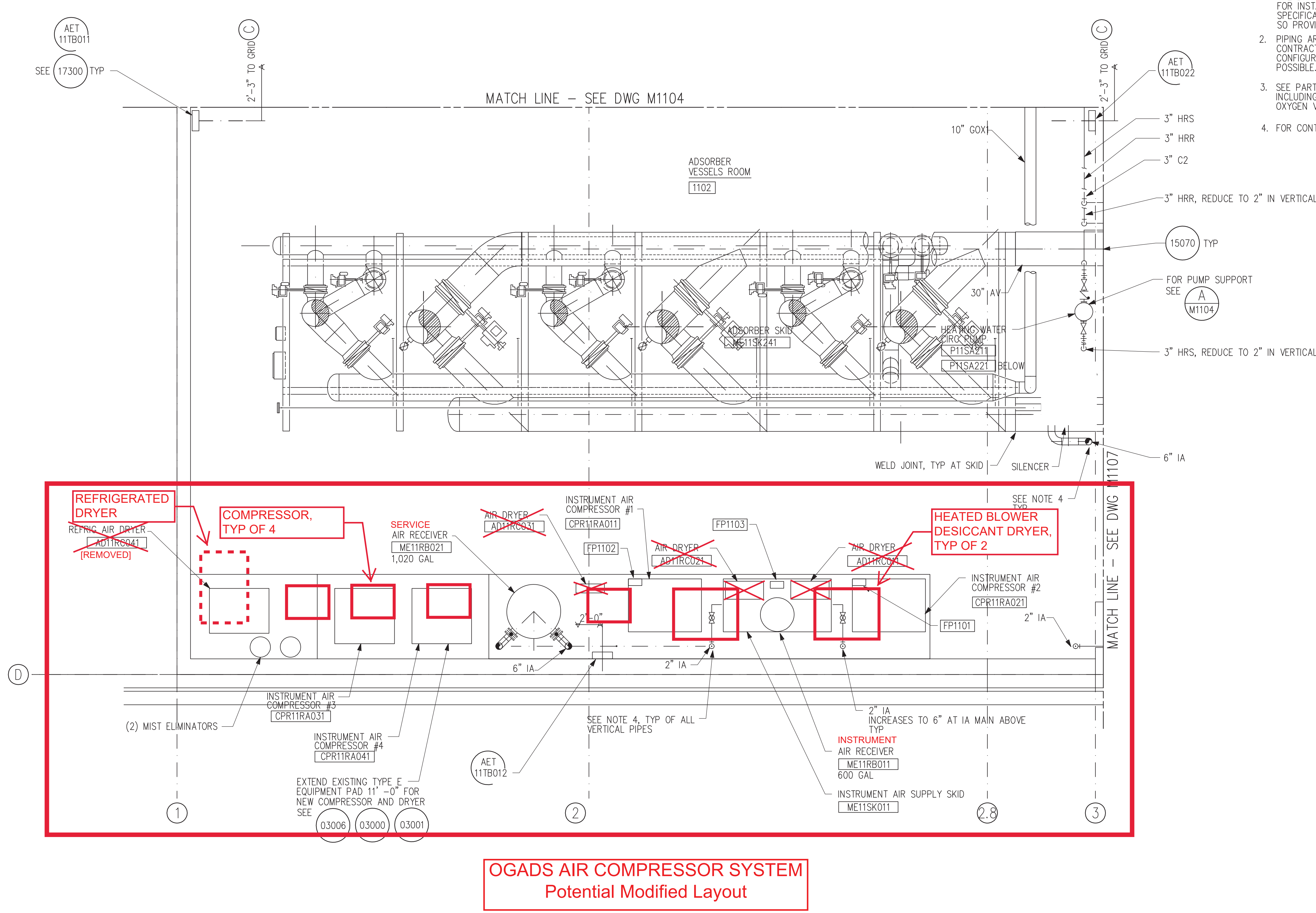
- Install refrigerated dryer for supplying SA from RSP (Section 2.3.2). This will address moisture contamination issues in SA distribution piping and reduce water load on other dryers at RSP.

4.4 Items to be Investigated During Alternatives Analysis and Detailed Design

The following are items the project team needs to investigate in more detail during alternatives analysis and detailed design:

- Investigate plant compressed air demands and needed capacity including pipe sizing and potential for future expansion
- Maintenance strategy (allowable downtime impacts)
- Control narrative and set points, including safety shutdowns and alarming
- PHA (process hazard analysis) to evaluate preventative and mitigative measures for what-if scenarios to address resiliency of the system
- Confirm that available power is adequate for new equipment loads
- Relocated and/or centralized IA/SA system
- Adjusting setup of IA and SA being served from OGADS and RSP during modifications
- Impacts of temporary compressed air systems to project schedule
- Space configuration of equipment at OGADS and RSP or at other locations
- Records and documentation requirements
- Overall lifecycle cost evaluation (operational expense, maintenance requirements/scope)
- Maintainability & Operability (isolation valves, bypass valve, crossover valves, etc.)
- O&M staffing requirements to support project (reviews, lockout, etc.)
- Current "step-down" PCVs (that reduce compressed air to SA and IA) fail position upon loss of control air
- Impacts of other WPTP construction projects that will happen at the same or nearby area and within the same construction timeframe (e.g., RSP Replacement, Primary Clarifiers Z-Roof Removal).

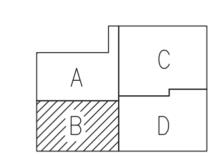
Appendix A
Plan Drawings



OGADS AIR COMPRESSOR SYSTEM
Potential Modified Layout

NOTES:

1. SELECTED EQUIPMENT AND OTHER MATERIALS SHOWN SCREENED ON THE DRAWINGS WILL BE FURNISHED UNDER PHASE ONE CONTRACT FOR INSTALLATION BY THE CONTRACTOR. REFER TO THE CONTRACT SPECIFICATIONS FOR SPECIFIC EQUIPMENT AND MATERIALS SO PROVIDED.
2. PIPING ARRANGEMENT SHOWN IS APPROXIMATE. CONTRACTOR SHALL ROUTE PIPING SO INSTALLED CONFIGURATION IS AS CLOSE TO THAT SHOWN AS POSSIBLE.
3. SEE PART F SHOP DRAWING 6430-329-201 FOR ADSORBER SKID, INCLUDING DIMENSIONS AND INTERFACE LOCATIONS, PROVIDED BY OXYGEN VENDOR AND INSTALLED BY CONTRACTOR.
4. FOR CONTINUATION OF VERTICAL PIPING SEE DWG M1109



KEY PLAN

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NO:	REVISION	BY	APP'D	DATE

ch2m

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ENGR:

DESIGNED: RH | FILE NO.:
DRAWN: RH | CHECKED: SB
RECOMMENDED: | APPROVED:
ORIG. CONTRACT: XXX
FACILITY DRAWING ISSUED:

King County

PLANT CODE: 711 | PATH: DMS/LOOPS | CAD CONTROL DATE: 19 October 2015

WEST POINT TREATMENT PLANT – VAS REPLACEMENT

OXYGEN GENERATION
GRADE LEVEL PLAN AREA B

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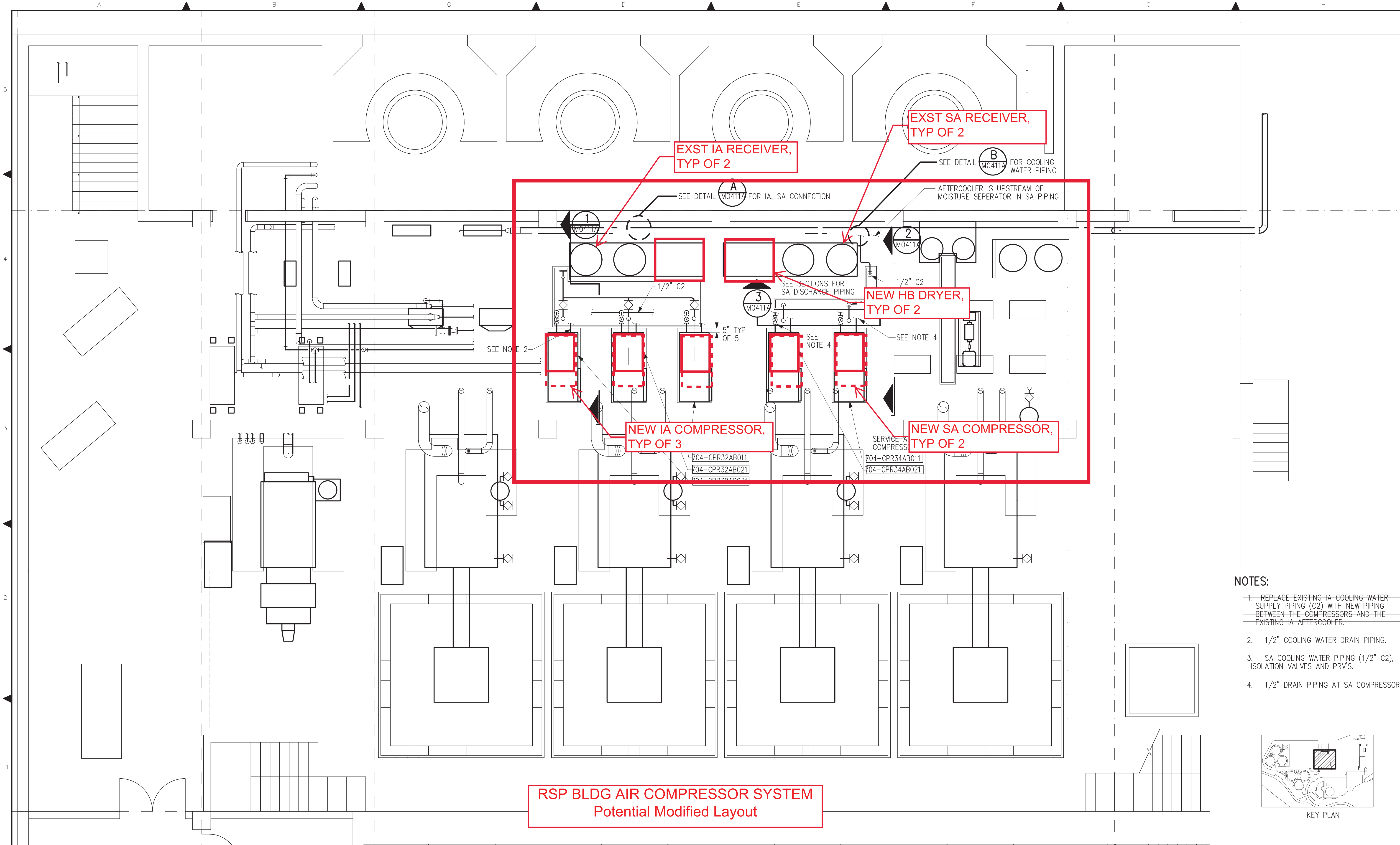

NOTES:

1. ~~REPLACE EXISTING IA COOLING WATER SUPPLY PIPING (C2) WITH NEW PIPING BETWEEN THE COMPRESSORS AND THE EXISTING IA AFTERCOOLER.~~
2. 1/2" COOLING WATER DRAIN PIPING.
3. SA COOLING WATER PIPING (1/2" C2), ISOLATION VALVES AND PRV'S.
4. 1/2" DRAIN PIPING AT SA COMPRESSORS.

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REFER TO ORIGINAL CONTRACT DRAWING FOR SIGNATURES AND SEALS

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RECOMMENDED:
APPROVED:
ORIG. CONTRACT: W/F6-91
FACILITY DRAWING ISSUED: DECEMBER 1996

King County

PLANT CODE: 704
PATH: DMS/ELECTRICAL
CAD CONTROL DATE: 1 May 2018
WEST POINT TREATMENT PLANT SECONDARY TREATMENT FACILITIES

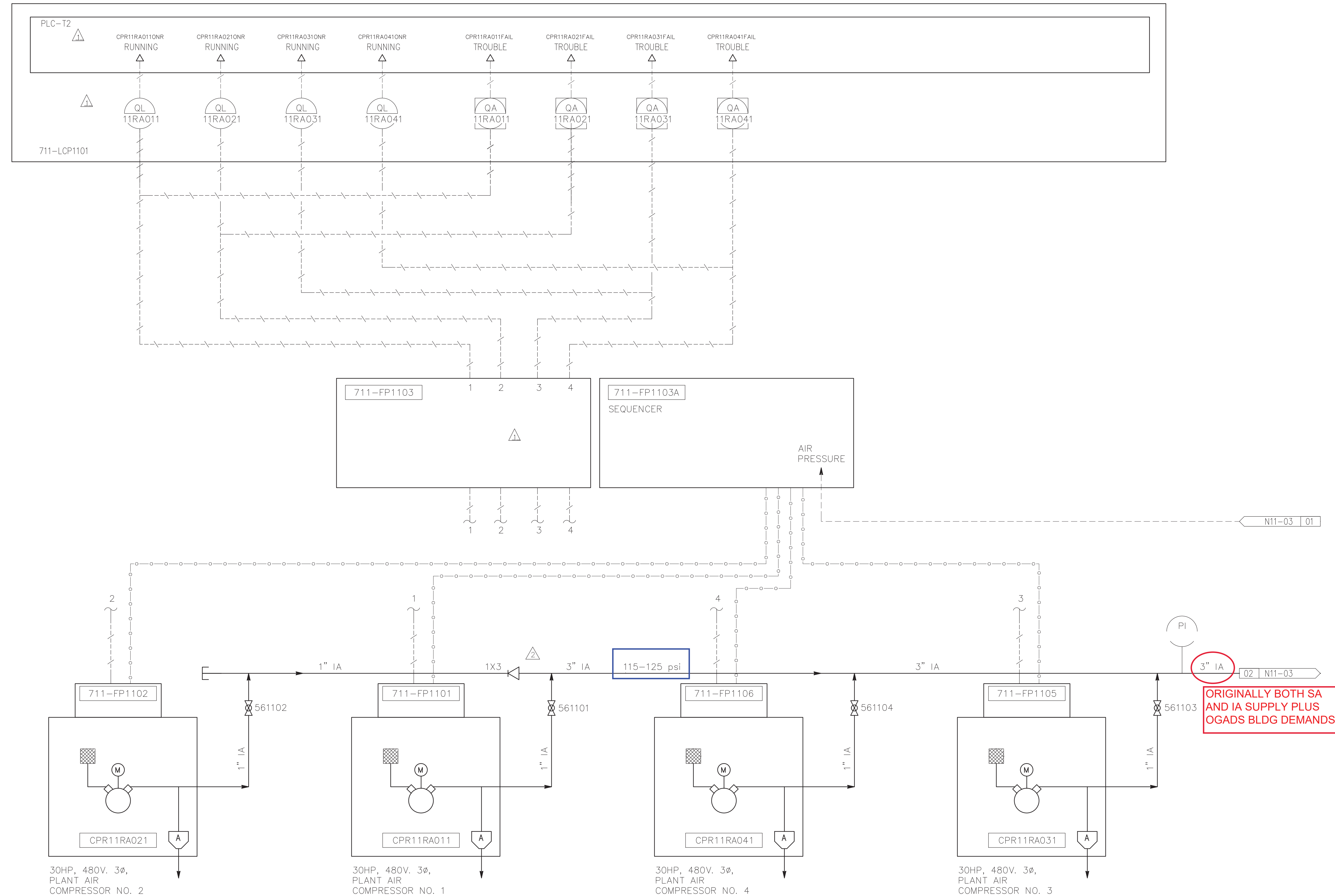
INSTRUMENT AIR AND SERVICE AIR COMPRESSOR PLAN

FILE NAME: M0403A.DWG
SCALE: 1/4" = 1'-0"
DRAWING NO: M0403A

Appendix B
P&IDs

SYMBOLS & ABBREVIATIONS

- TT — TEMPERATURE TRANSMITTER
- FT — FLOW TRANSMITTER
- PT — PRESSURE TRANSMITTER
- PI — PRESSURE INDICATOR
- PS — PRESSURE SWITCH
- AIT — ANALOG TRANSMITTER
- AIT — ANALOG TRANSMITTER
- QL 00 — ON – OFF INDICATING LIGHT
- HS 00 — HAND SWITCH, ON – OFF
- ANALOG SIGNAL
- DISCRETE SIGNAL
- SOFTWARE OR DATA LINK
- PLC DISCRETE INPUT
- PLC DISCRETE OUTPUT
- PLC ANALOG INPUT
- PLC ANALOG OUTPUT
- NO NC BALL VALVE 2
- A AUTOMATIC DRAIN
- M MOTOR
- PRESSURE RELIEF VALVE
- S SOLENOID
- N.O. N.C. GATE VALVE
- CONCENTRIC REDUCER 2



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TYPICAL NO.:
ILD NO.:
LINKED TO DATABASE:

ENGR: ENGR:

DESIGNED: FILE NO.: DRAWN: CHECKED: RECOMMENDED: APPROVED:
ORIG. CONTRACT: C53077C
FACILITY DRAWING ISSUED: DECEMBER 2006

King County

PLANT CODE: 711 PATH: DMS/PIDS CAD CONTROL DATE: 18 November 2015

WEST POINT TREATMENT PLANT SECONDARY TREATMENT FACILITIES
FOURTH AIR COMPRESSOR INSTALLATION

OXYGEN GENERATION COMPRESSED AIR

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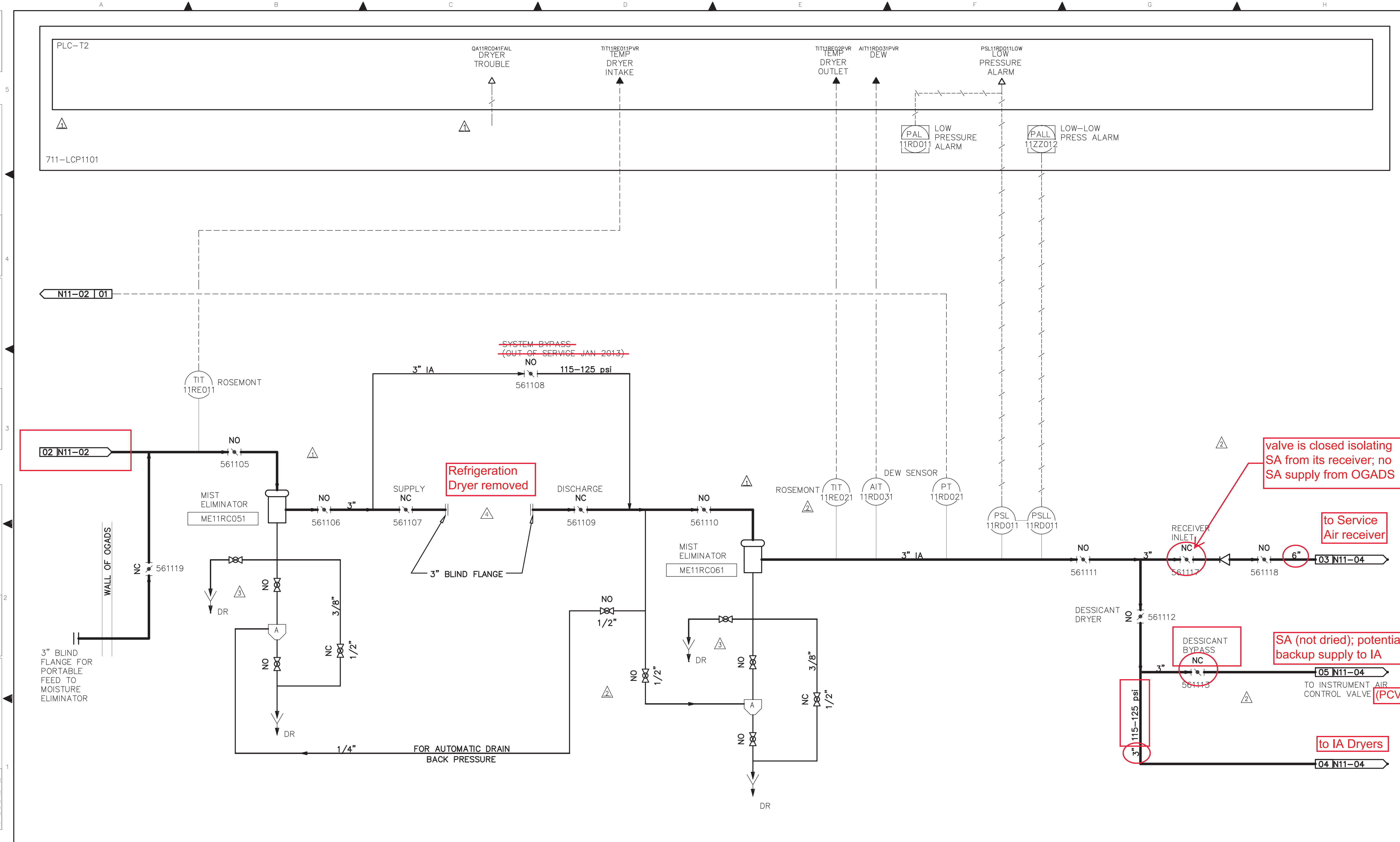

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FACILITY DRAWING ISSUED: DECEMBER 2006

King County

PLANT CODE: 711
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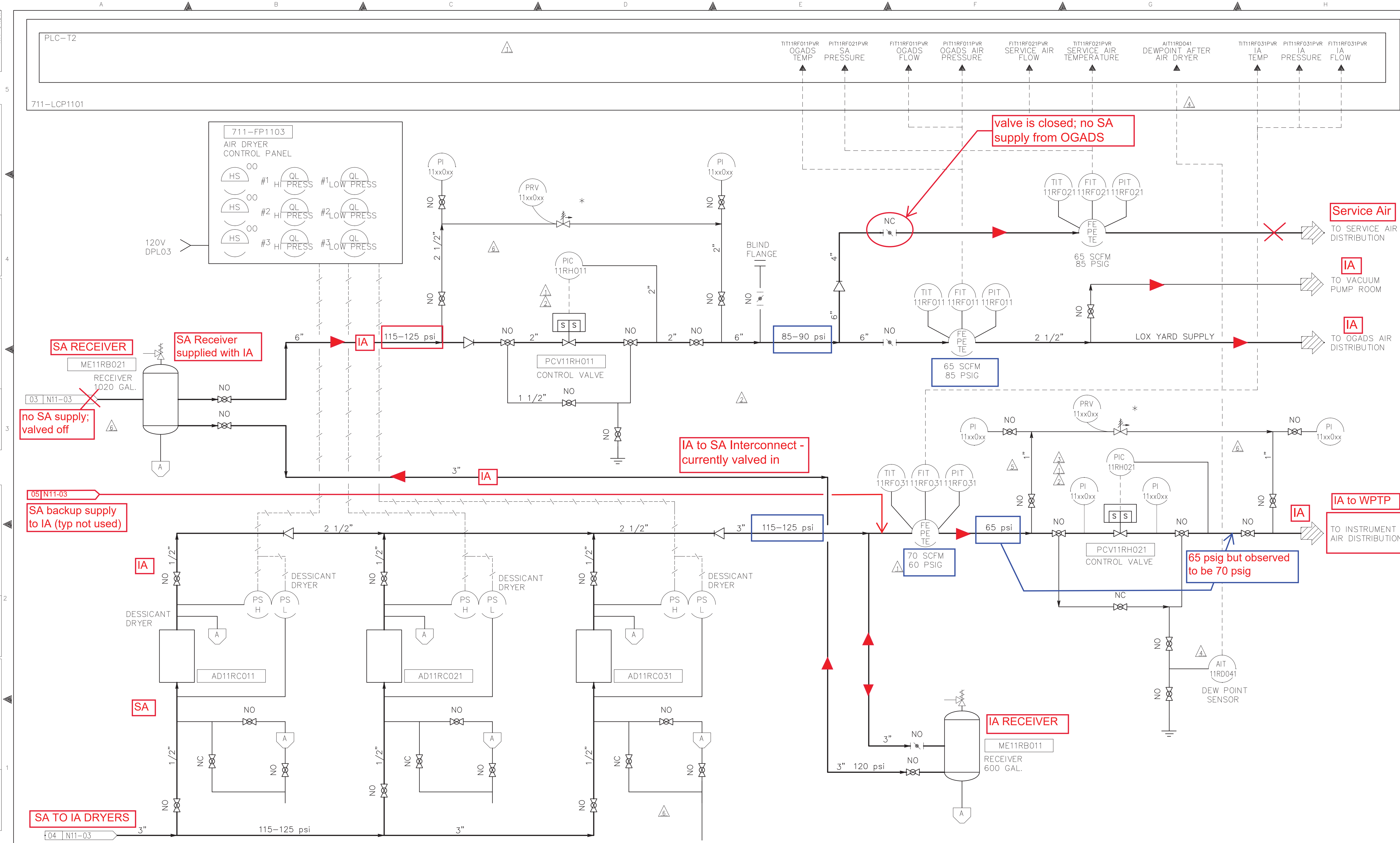
WEST POINT TREATMENT PLANT SECONDARY TREATMENT FACILITIES
4TH AIR COMPRESSOR INSTALLATION

OXYGEN GENERATION COMPRESSED AIR



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King County

PLANT CODE: 711
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WEST POINT TREATMENT PLANT SECONDARY TREATMENT FACILITIES
4TH AIR COMPRESSOR INSTALLATION

OXYGEN GENERATION
COMPRESSED AIR

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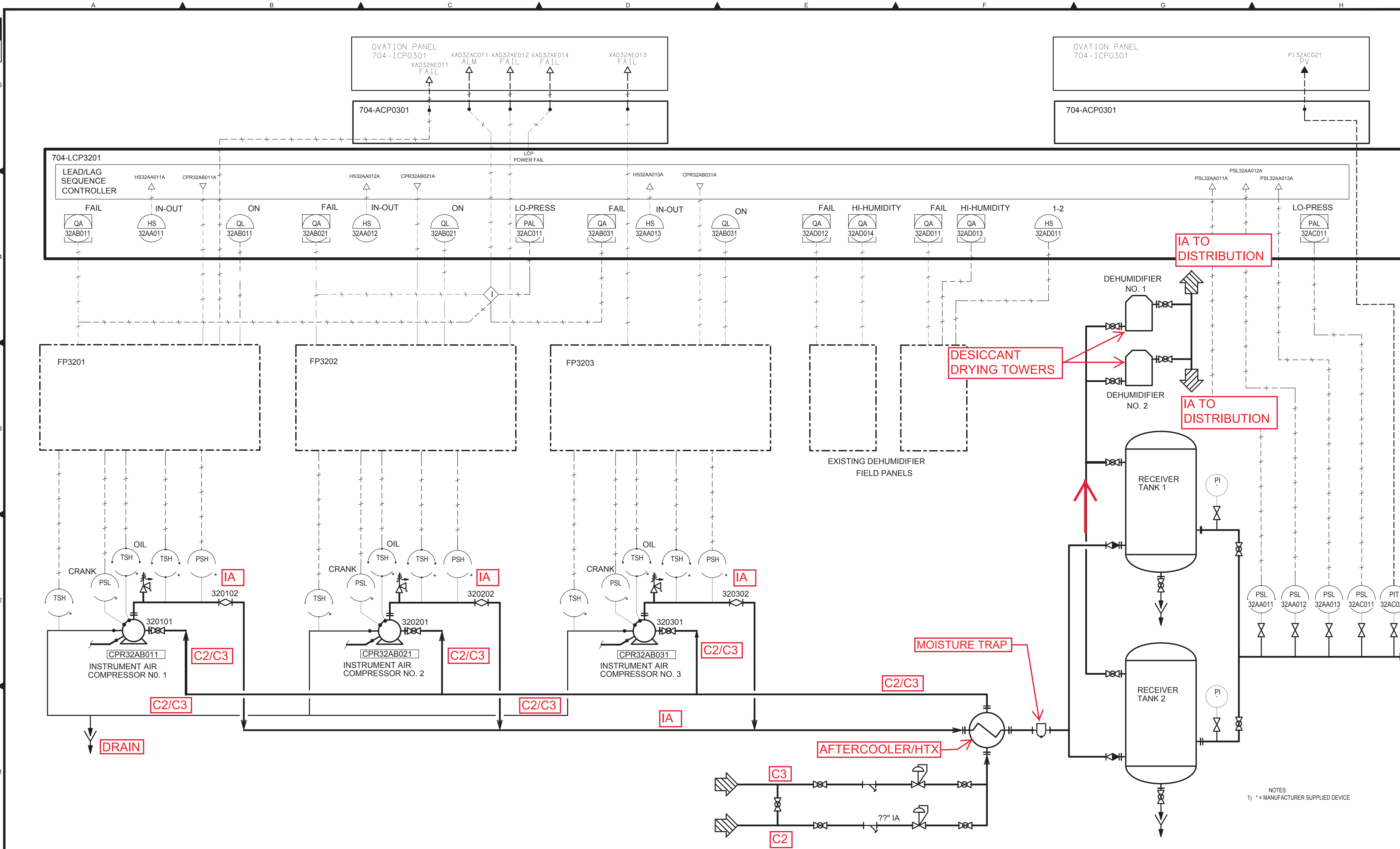

LAST EDITED BY: rdavey2, Mon, 08 Feb 2016 - 10:07am
FILENAME: N32-01.dwg
LAYOUT: INSTRUMENT AIR COMPRESSORS
XREFS:

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GRID AREA: ALL

ORIGINAL CONTRACT NO:

ORIGINAL CONTRACT NAME:

MOST RECENT CONTRACT NO: C00811C13

MOST RECENT CONTRACT NAME: WPTP OVATION - VC PACKAGE

King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
WEST POINT TREATMENT PLANT

RSP INSTRUMENT AIR COMPRESSORS

FACILITY CODE: 704

CAD FILE NAME: N32-01.DWG

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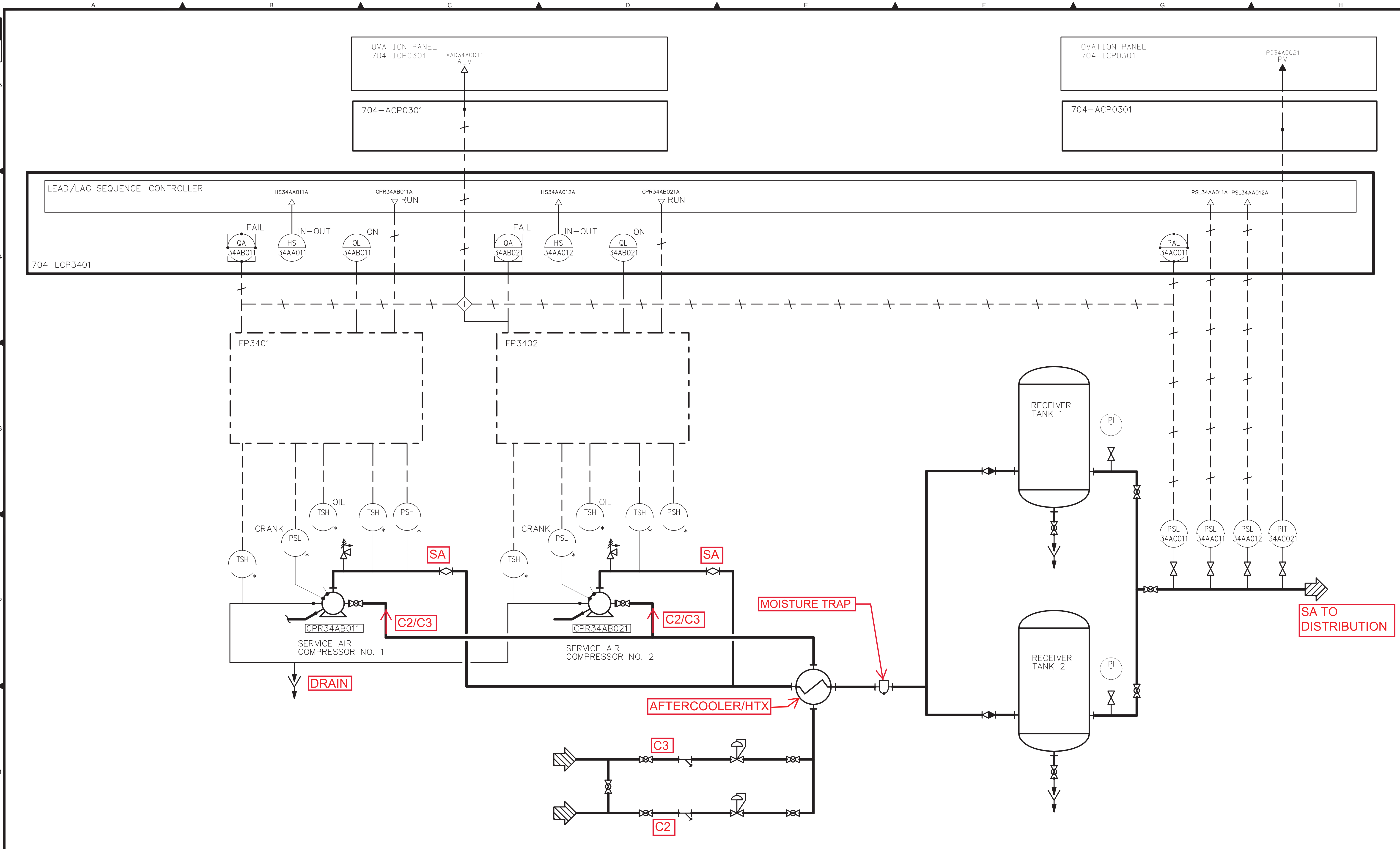

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MOST RECENT CONTRACT NAME: WPTP OVATION - VC PACKAGE

King County

DEPARTMENT OF NATURAL RESOURCES & PARKS
WASTEWATER TREATMENT DIVISION
WEST POINT TREATMENT PLANT

RSP SERVICE AIR COMPRESSORS

FACILITY CODE: 704

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LAST EDITED BY: rdavey2, Mon, 08 Feb 2016 - 10:07am
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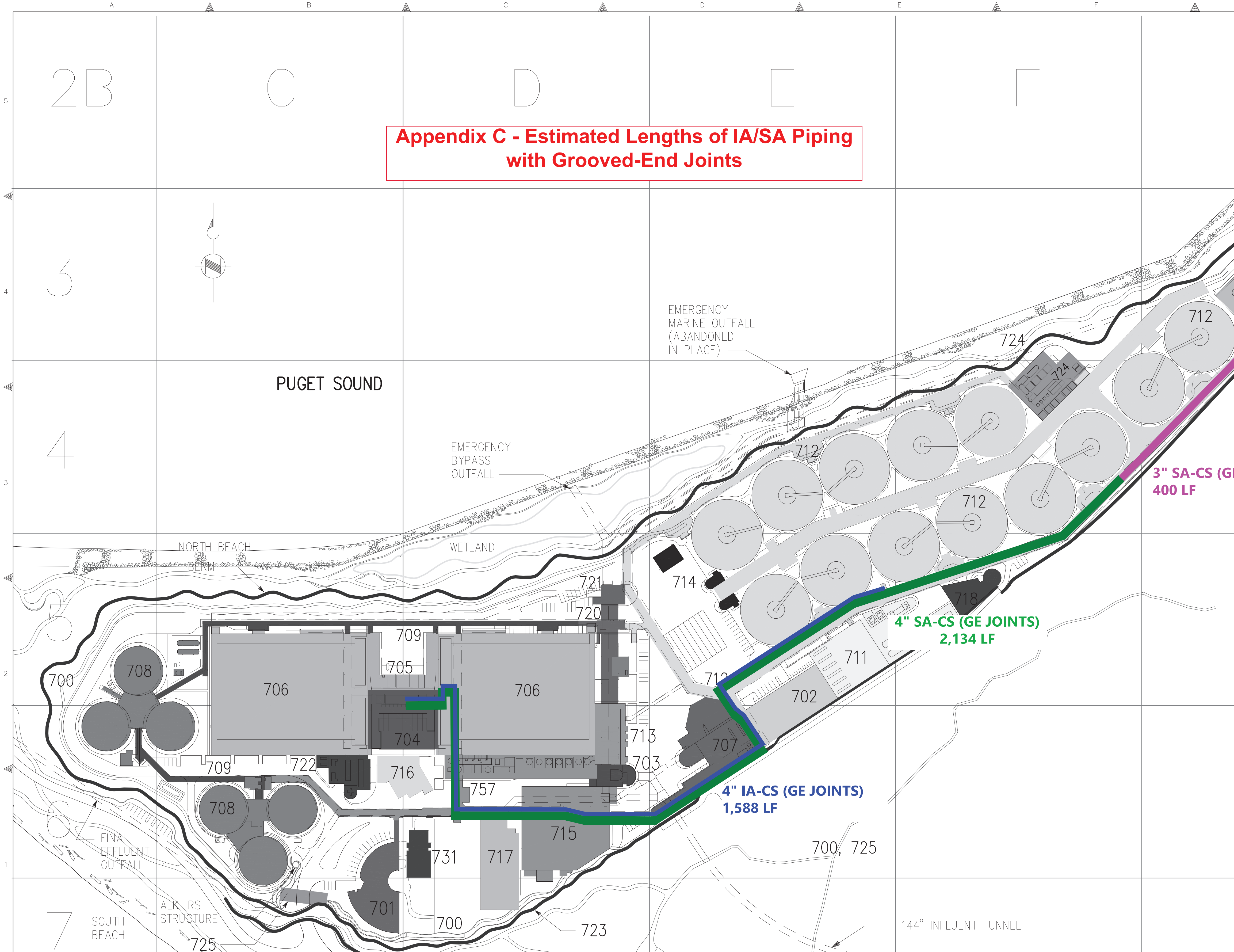
Appendix C
Schematic for Pipe Rehabilitation

Appendix C - Estimated Lengths of IA/SA Piping with Grooved-End Joints



WEST POINT TREATMENT PLANT
FACILITIES REFERENCE KEY

700	YARD PIPING, CIVIL, SITE-WIDE SYSTEMS
701	ADMINISTRATION/OPERATIONS CENTER
702	MAINTENANCE BUILDING
703	INFLUENT CONTROL STRUCTURE (ICS)
704	RAW SEWAGE PUMP BUILDING (RSPB)
705	GRIT/SCREENINGS HANDLING, BOILERS
706	WEST/EAST PRIMARY SEDIMENTATION
707	EFFLUENT PUMPING STATION (EPS)
708	DIGESTERS, PROPANE, WASTE GAS
709	PRIMARIES/DIGESTER GALLERIES
710	AERATION TANKS & GALLERY
711	OXYGEN GENERATION FACILITY (OGADS)
712	SECONDARY SED, CONTACT CHANNEL, GALLERIES
713	STORAGE, "FACILITY 713" FUTURE USE TBD
714	HYPOCHLORITE DISINFECTION & MIX STRUCTURE
715	SOLIDS HANDLING, GALLERY, ODOR CONTROL
716	INFLUENT SCREENINGS BUILDING
717	MULTI-USE FAC (MUF), WASTE TO ENERGY (W2E)
718	FACILITY SERVICES AND FS ANNEX
720	BYPASS & INFLUENT CHANNELS, WASTE GAS INCINERATORS
721	FLOW DIVERSION STRUCTURE (FDS)
722	WP MAIN ELECTRICAL SUBSTATION
723	HILLSIDE RETAINING WALL
724	INTERMEDIATE PUMP STATION (IPS)
725	WP ENTRY PORTAL, LANDSCAPING, IRRIGATION
731	ADMINISTRATION ANNEX BUILDING
757	WATER REUSE SYSTEM

NO:	REVISION	BY	APP'D	DATE
2	ADDED NEW ADMIN ANNEX & SCREENINGS FACS - CWL1000	JLR	JLR	APR 12
1	ADDED NEW HYPO FACILITY & SITE GRID - CWL 963	JLR	JLR	SEP 11
	NEW DRAWING	JLR	TWF	JUL 01

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 — 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

DESIGNED: | FILE NO: W87
DRAWN: JLR | CHECKED:
RECOMMENDED: | APPROVED:
ORIG CONTRACT: | ST:
FACILITY DRAWING ISSUED: JULY 2001

King County

PLANT CODE: 700 | PATH: DMS/GENERAL | CAD CONTROL DATE: 8 APRIL 2014
WEST POINT TREATMENT PLANT SECONDARY TREATMENT FACILITIES
WEST POINT TREATMENT PLANT

SITE WIDE
FACILITIES PLAN

INDEX NO.: FACILITIES.DGN
SCALE: 1" = 100'
DRAWING NO: FACILITIES

Appendix D
Site Pictures

RSP Air Compressors

RSP Air Compressors

Figure D-1. RSP Compressors

IA Receivers

IA Dryers

IA Dryers

Figure D-2. RSP IA Dryers and Receivers

IA Aftercooler/HTX

IA Moisture Trap

SA Receivers

SA Receivers

Figure D-3. RSP IA and SA Equipment

Starting Air System

Figure D-4. RSP Starting Air System

Compressors 3-4 & Mist Eliminators

Mist Eliminators

Figure D-5. OGADS Compressors 3 – 4 and Mist Eliminators

OGADS Air System

OGADS Air System- Compressor 2 – Dryer #3 - SA Receiver

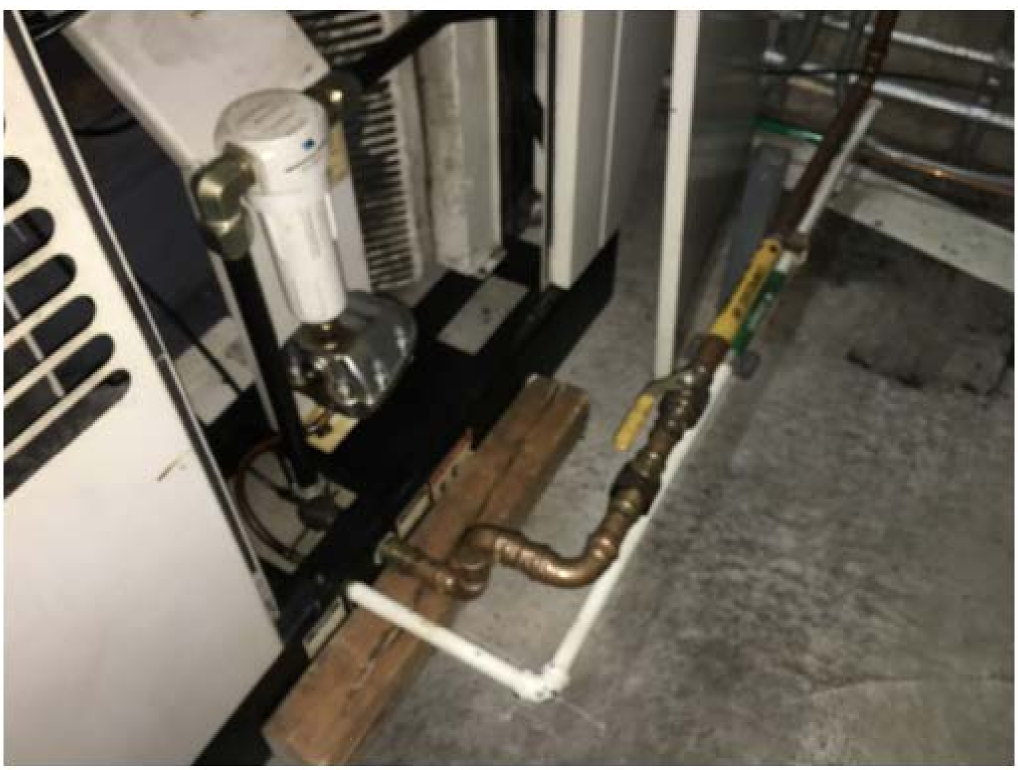
Figure D-6. OGADS Air System

Rotary Screw Compressor 3 Panel Face

Rotary Screw Compressor 2

Figure D-7. OGADS Compressors

Desiccant Air Dryer Towers Nos. 1 & 2



Compressor 3 Automatic Condensate Drain

Figure D-8. OGADS Air Dryer Towers 1 and 2, Compressor 3 Drain

Comp 3 Auto Drain Valve

Comp 1 Auto Condensate Drain

IA Pressure Control

Figure D-9. OGADS Compressor Drains and IA Pressure Control

IA PCV

SA Pressure Control

SA PCV

Figure D-10. OGADS IA and SA Controls

OGADS Air – SA Receiver

Figure D-11. OGADS SA Receiver

Old Refrigeration Dryer [removed]

Figure D-12. OGADS Old Refrigerated Dryer