

**BROOKHAVEN NATIONAL LABORATORY
PROCESS ASSESSMENT FORM**

I. General Information

Process ID:	AGS-004-CWS		
Process Name:	AGS Cooling Water Systems		
Process Flow Diagrams:	AGS-004-CWS-01 through 22		
Process Description:	<p>This process includes the C-A Department cooling water systems associated with the Alternating Gradient Synchrotron (AGS) at BNL including the Linac, Booster ring, BAF, main AGS ring, primary/experimental beam lines and g-2 experiment. Numerous AGS cooling water systems are utilized for cooling magnets, electrical equipment, RF cavities, buildings and various types of equipment. Equipment utilized to transfer or reject heat from the cooling water includes heat exchangers, chillers, evaporative coolers and cooling towers. The AGS cooling water systems include closed loop, open loop and once through systems. As required, cooling water is supplied from the BNL potable water system and, if within acceptable limits, is discharged to the AGS recharge basins, storm system or BNL sanitary system. Some cooling water systems have become activated due to radiation from the AGS beam. Section II and the above-referenced Process Flow Diagrams provide more detail on the AGS cooling water systems. In addition to the AGS cooling water systems, the ion exchange system for the Tandem Van de Graaff is included in this PAF.</p>		
Dept./Div.:	Collider Accelerator		
Dept. Code:	AD		
Building(s):	902, 911, 912, 912A, 913, 914, TE Bldg., 919, 919B, 925, 928, 930, 932, 944, 946, 901 (Tandem Van de Graaff)		
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II. Detailed Process Descriptions and Waste Determination

The Alternating Gradient Synchrotron (AGS) cooling water systems located within various buildings at Brookhaven National Laboratory (BNL) have been organized into 22 major processing units, identified as 1.0 through 22.0. Process Flow Diagrams AGS-004-CWS-01 through 22, provided in Attachment 1, graphically depicts the process inputs and outputs for the AGS cooling water systems. Table 1, provided by BNL and included as Attachment 2, summarizes the AGS cooling water systems and some of the major system components. The Tandem Van de Graaff cooling water ion exchange system is also included in this PAF.

The AGS is utilized to produce high energy protons, polarized protons and heavy ions for use in various experiments developed to study the fundamental characteristics of matter and the biological effects of high proton-number, high-energy radiation. The AGS facility is composed of a ½-mile circumference accelerator ring, a 1/8-mile circumference booster ring, a linear accelerator or Linac, the Tandem van de Graaff (TVDG), NASA Space Radiation Laboratory (NSRL) and the Relativistic Heavy Ion Collider (RHIC). The Relativistic Heavy Ion Collider (RHIC) cooling waters systems Process Evaluation is a separate document. Numerous AGS cooling water systems include the Linac, Booster ring, main AGS ring, NSRL, primary/experimental beam lines and g-2 experiment. Cooling water systems are utilized to cool magnets, electrical equipment, RF cavities, buildings and various types of equipment. Each cooling water system includes a primary cooling water system that accepts heat from a particular source or load. The primary cooling water system may be a closed loop, open loop or once through system. Heat is transferred from the primary cooling water system to a secondary cooling water system utilizing a heat exchanger or chiller, or heat is directly rejected from the primary cooling water system to an evaporative cooler or cooling tower, or the primary cooling water is discharged as part of a once through system.

Chemicals utilized by the AGS Department for maintaining cooling tower systems include biocide (Biosperse 254), corrosion inhibitor (Drew 2135) and dispersant (DrewBROM 1-L). A complete list of chemicals used can be found in Section III. In order to minimize chemical usage, chemicals are added to the cooling tower water based on the volume of make-up water added to the system. As discussed in the RHIC Cooling Water Systems PAF, BNL is currently evaluating the use of alternate chemicals and non-chemical systems for maintaining cooling tower systems. The alternate chemicals are currently being utilized and evaluated as part of the Linac cooling tower system. The non-chemical, ozone treatment systems are installed within the RHIC cooling water system at BRAHMS and PHOBOS and at AGS, NSRL and the Special Experimental Magnet (SEM) Cooling Water System.

Cooling water is supplied by the BNL potable water system. Some cooling water systems have become activated due to radiation from the particle beam. These systems are denoted on the Process Diagrams with double lines. Other cooling-water systems are activated slightly, and contain activation products at concentrations below the drinking water standard. These systems are denoted on the Process Diagrams by dotted lines. Other systems are non-radioactive or indistinguishable from background levels (i.e., below the Minimum Detection Limit (MDL))¹. These systems are denoted on the Process Diagrams as solid lines.

¹ Minimum Detection Limit (MDL) for tritium analysis of cooling water was 3.88-4.49E-6 uCi/ml
C-A-OPM 14.4

Wastes, effluents and air emissions generated by AGS cooling water systems include cooling water discharges, cooling tower blow down, cooling tower emissions, spent bag filters and spent deionizer resin. Cooling water removed from activated systems is containerized, analyzed for radiological parameters and is typically transferred to the Environmental and Waste Management Services Division (EWMSD) for processing as radioactive wastewater. Cooling tower blow down is discharged to the AGS recharge basins, storm system or BNL sanitary system. Water vapor emissions from cooling towers are released to air. Solid wastes (i.e., filters, resins, etc.) are managed as radioactive or non-radioactive depending on survey, sampling and analysis.

Spent bag filters are surveyed for radioactivity and then disposed of accordingly. Typically, bag filters are disposed of approximately once per year. Unlike the RHIC cooling water systems, many of the AGS cooling water systems do not utilize filters. As of 1997, the AGS no longer regenerates deionizer resin on-site. The deionization process has been replaced with a resin replacement process, since the regeneration process had resulted in the generation of significant volumes of radioactive wastewater (approximately 15,000-gallons/year). Deionizer resin is transported off-site for disposal as low-level radioactive waste and replaced with new deionizer resin. Deionizer resin is removed and replaced approximately every 2 years.

In the late 1990's, the C-A Department changed the supply source of water used for heat rejection in the AGS Main Magnet System from AGS well water to BNL potable water. The switch eliminated the need for chemical treatment of supply water. Other benefits of this change include less iron fouling of heat exchangers, less water treatment chemical handling, and less fouling of recharge basins. In addition, within the next several years, the AGS Department expects that each closed loop cooling water system will have a dedicated make-up water deionizer and polishing deionizer. Make-up deionizers are utilized for incoming BNL potable water and polishing deionizers are utilized within the cooling system to reduce the conductivity of the cooling water, as required. The increase in make up water deionizers will result in less frequent deionizer resin change-outs.

Pumps utilized by the AGS cooling water systems contain very small quantities of lubricating oil (typically a few ounces). Secondary containment trays are provided for pumps that leak small amounts of oil. In general, used oil is surveyed for radioactivity and disposed of as radioactive waste or industrial waste based on the survey results. The majority of used oil generated by the C-A Department is not from cooling water pumps but from vacuum pumps and power supplies as discussed in the evaluation of Experimental Beam line Construction & Disassembly (see AGS-002-EBC), therefore used oil is not included in this PAF.

Several AGS cooling water systems utilize converters (heat exchangers) which transfer steam heat to the cooling water systems when the normal heat load is absent and extreme weather conditions dictate that heat be added for freeze protection. This enables the cooling water system to continue operating without interruption. Steam is supplied by the BNL steam plant and the condensate is then returned to the steam plant as part of a closed loop system.

Regulatory Determination of Process Outputs

1.0 Main Magnet System (Bldgs. 911/913)

The main magnet cooling water system, located in Buildings 911 and 913, is utilized to cool the AGS ring magnets, a reference magnet and Special Ejection and Warm Snake magnets in the AGS ring (refer to process flow diagram AGS-004-CWS-01). Due to exposure to the AGS beam, the main magnet cooling water is radioactive or “activated”. The primary cooling water system is a closed loop system that transfers heat from the magnets to the cooling water. Heat from the cooling water is indirectly rejected (non-contact) to air utilizing eight evaporative coolers and transferred to BNL potable water utilizing the Main Magnet heat exchanger. Water drained or otherwise collected from the primary loop is collected in tanker trailers where it is stored for reuse/recycle, or evaporated or disposed of as radioactive waste. Make-up water for the systems is supplied by the BNL potable water system. Water for the evaporative coolers sprays down over the coils and re-circulates after which it is discharged to the storm system (outfall 002, recharge basin HN). Potable water from the heat exchanger is discharged to the mix/ waste tank (next to Building 951) and then the AGS recharge basins (outfall 003, recharge basin HO). Potable water vapor from the evaporative coolers is released to ambient air. The main magnet system has an inline full flow filter and a separate polishing deionizer and potable water make-up deionizer. Spent filter bags from the full-flow filter are disposed of as low-level radioactive waste approximately once a year. Spent make-up deionizer resin and spent polishing deionizer resin are exchanged on-site approximately every 2 years and the spent resins are drummed, sampled and disposed based on sample analysis results. The main magnet system also utilizes a steam converter as part of the primary system, as required. Condensate from the converter is returned to the BNL steam plant as part of a closed loop system.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
1.1	Evaporative cooler blow down and cleaning water (potable water)	Non-hazardous/ non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the storm system (outfall 002, recharge HN)	None
1.2	Water from the secondary side of the main magnet heat exchanger (potable water)	Non-hazardous/ non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the mix/waste tank and then AGS recharge basins (outfall 003, recharge HO)	None
1.3	Water vapor from evaporative cooler (potable water)	Non-hazardous/ non-radioactive vapors as determined by process knowledge	Evaporated water is released to ambient air	None

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
1.4	Inline bag filters	Non-hazardous/ radioactive solid waste as determined by process knowledge/ radioactivity survey	Waste is sent off- site for disposal as low level radioactive waste	None
1.5	Make-up deionizer resin (potable water)	Non-hazardous/ non-radioactive solid waste as determined by process knowledge	Spent resin is removed transported off-site for disposal.	None
1.6	Polishing deionizer resin	Non-hazardous/ radioactive solid waste as determined by process knowledge/ radioactivity survey	Spent resin is removed transported off-site for disposal.	None
1.7	Converter steam condensate	Non-hazardous/ non-radioactive water as determined by process knowledge	Water is returned to the BNL steam plant as part of a BNL closed loop steam distribution system	None
1.8	Main Magnet Cooling Water (primary)	Non-hazardous/ radioactive water as determined by process knowledge	Water that is collected in tankers is not initially waste and can be recycled. Liquid waste, if any, is disposed of as radioactive waste.	None

2.0 Westinghouse System (Bldg. 911)

The Westinghouse motor generator (MG) is used as a backup system to the Siemens MG set. The cooling water system, located in Building 911, is a once through system utilized to cool oil and the liquid rheostat within the Westinghouse generator (refer to process flow diagram AGS-004-CWS-02). The cooling system can also be used for power supply test cooling. Additional heat loads may be added to this system as part of planned AGS upgrades. Water is supplied to the system by the BNL potable water system, passes through the heat loads and then is discharged to the mix/waste tank (outside Building 951) and AGS recharge basins (outfall 003, recharge HO).

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
2.1	Water from the Westinghouse MG set	Non-hazardous/non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the mix/waste tank and then AGS recharge basins (outfall 003, recharge HO)	None

3.0 Experimental System and Cooling Tower No. 1 (Bldgs. 911/912)

There are four experimental beam line cooling-systems, each with an associated cooling tower. Experimental system No. 1, located in Buildings 911 and 912, is utilized to cool magnets and power supplies for the experimental beam lines (refer to process flow diagram AGS-004-CWS-03). The system has four pumps, two located in the 911 pump room and two on the west balcony of 912 near Cooling Tower No. 1. Although the experimental cooling systems are exposed to the beam, the systems are only slightly activated due in part to the large volume of make-up water required to keep the cooling water conductivity within acceptable values. The cooling water in this system contains activation products but at concentrations below the drinking water standard and below the MDL. The primary cooling water system is an open system that transfers heat from the experimental magnets and power supplies to the cooling water and then rejects the heat directly to the BNL storm system via once through potable water. The cooling tower is currently not operating and only potable water is used.. Make-up water for the cooling system is supplied by the BNL potable water system and added to the cooling tower. Biocide is added to the cooling water prior to entering the cooling tower. Cooling tower blow down and cleaning water is discharged to the storm system (outfall 002, recharge HN). Water vapor from the cooling tower is released to ambient air.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
3.1	Cooling tower blow down and cleaning water (w/biocide) that does not contain accelerator produced radionuclides above the MDL	Non-hazardous effluent / radiological testing	Wastewater is discharged to the storm system (outfall 002, recharge HN).	None
3.2	Emission from cooling tower containing tritiated water vapor and several other short half-life non-respirable radionuclides (w/biocide)	Non-hazardous radioactive air emission below NESHAP level requiring continuous monitoring.	Vapors are released to ambient air. Release is within permissible levels.	None

4.0 Fast Quad System (Bldgs. 911/951)

The AGS fast quad cooling water system, located in Building 911 and the TE Building, is utilized to cool power supplies and cryogenics (refer to process flow diagram AGS-004-CWS-04). The primary cooling water system is a closed loop primary system that transfers heat from the power supplies to the cooling water. Non-contact water from the heat exchanger is discharged to the mix/waste tank (outside Building 951) and then the AGS recharge basins (outfall 003, recharge HO). Due to exposure to the AGS beam, the primary closed loop cooling water may become activated. Tritium concentrations in the primary loop have ranged from 64,000 pCi/ml to below the MDL (~0.4 pCi/ml). Water drained or otherwise collected from the primary loop is collected in tanker trailers where it is stored for reuse/recycle, or evaporated or disposed of as radioactive waste. Make-up water for the primary loop and heat exchanger is supplied by the BNL potable water system. Non-contact water from the heat exchanger is discharged to the mix/waste tank (outside Building 951) and then the AGS recharge basins (outfall 003, recharge HO). The fast quad system has one deionizer that is utilized for both make-up water and polishing. Filters are located before and after the deionizer within the polishing loop of the primary cooling water system. Spent filter bags are surveyed for radioactivity and disposed of, approximately once a year based on survey results. Spent deionizer resins are drummed, sampled and disposed based on sample analysis results.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
4.1	Water from the secondary side of the fast quad heat exchanger (potable water)	Non-hazardous/non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the mix/waste tank and then AGS recharge basins (outfall 003, recharge HO)	None
4.2	Bag filters	Non-hazardous/radioactive or non-radioactive solid waste as determined by process knowledge/radioactivity survey	If radioactive, sent off-site for disposal as low level radioactive waste; if non-radioactive discarded as trash	None
4.3	Make-up/polishing deionizer resin	Non-hazardous/radioactive or non-radioactive solid waste as determined by process knowledge/radioactivity survey	Spent resin is removed transported off-site for disposal.	None

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
4.4	Fast Quad Cooling Water (primary)	Non-hazardous/ radioactive water as determined by process knowledge	Water that is collected in tankers is not initially waste and can be recycled. Liquid waste, if any, is disposed of as radioactive waste.	None

5.0 Experimental System/Cooling Tower No. 2 (Bldg. 912)

THIS SYSTEM IS NOT OPERATIONAL – Magnets and Power Supplies have been removed and the Cooling Tower is shut down.

The Experimental System/Cooling Tower No. 2, located in Building 912, are combined into one cooling water system (refer to process flow diagram AGS-004-CWS-05). The Experimental System cooling water loop circulates through experimental magnets and power supplies and is released to air by Cooling Tower No. 2. Cooling Tower No. 2 is located east of Building 912. Experimental system No. 2 (secondary system), is an open system that transfers heat from the experimental beam line magnets and power supplies in Bldg. 912, to the Experimental System cooling water utilizing a heat exchanger. The Experimental System cooling water then rejects the heat directly to air through Cooling Tower No. 2. Water drained or otherwise collected from the primary loop is collected in tanker trailers where it is stored for reuse/recycle, or evaporated or disposed of as radioactive waste. Although the Experimental System cooling system is exposed to the beam, the system is only slightly activated due in part to the large volume of make-up water required to keep the cooling water conductivity within acceptable values. The cooling water in this system contains activation products but at concentrations below the EPA drinking water standards. Make-up water for the cooling systems is supplied by the BNL potable water system. Biocide is added to the experimental system prior to entering the cooling tower. Cooling tower blow down and cleaning water is discharged to the storm system (outfall 002, recharge HN). Water vapor from the cooling tower is released to ambient air. A NESHAP evaluation of the air emission was conducted in 1998, and found the site boundary dose to be below the level requiring continuous monitoring (i.e., less than 0.1 mrem/yr at the site boundary). Periodic water testing is performed to demonstrate compliance. Experimental

System No. 2 has an inline filter. The make-up deionizer-resin and polishing deionizer resin are exchanged on-site approximately every 2 years and resins are drummed, sampled and disposed based on sample analysis results.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
5.1	Cooling tower blow down w/biocide and cleaning water containing activation products in concentrations less than the drinking water standard	Non-hazardous/ radioactive effluent as determined by process knowledge, sampling and analysis.	Wastewater is discharged to the storm system (outfall 002, recharge HN). Release is within permissible levels	None
5.2	Emission from cooling tower containing tritiated water vapor and several other short half-life radionuclides (w/biocide)	Non-hazardous radioactive air emission below NESHAP level requiring continuous monitoring.	Vapors are released to ambient air. Release is within permissible levels.	None
5.3	Experimental system No. 2 inline bag filter	Non-hazardous/ radioactive or non-radioactive solid waste as determined by process knowledge/ radioactivity survey	If radioactive, sent off-site for disposal as low level radioactive waste; if non-radioactive discarded as trash	None

6.0 Experimental System and Cooling Tower No. 3 (Bldg. 912)

Experimental system No. 3, located in Building 912, is utilized to cool magnets and power supplies for the experimental beam lines (refer to process flow diagram AGS-004-CWS-06). Although the experimental cooling system is exposed to the beam, the system is only slightly activated due in part to the large volume of make-up water required to keep the cooling water conductivity within acceptable values. The cooling water in this system contains activation products but at concentrations below the drinking water standard and below the MDL. This primary cooling water system is an open system that transfers heat directly from the experimental magnets and power supplies to the cooling water and then rejects the heat directly to air utilizing a cooling tower. Cooling Tower No. 3 is located just north of Cooling Tower No. 2. Make-up water for the cooling system is supplied by the BNL potable water system and

added to the cooling tower. Biocide is added to the cooling water before leaving the cooling tower. Cooling tower blow down and cleaning water is discharged to the storm system (outfall 002, recharge HN). Water vapor from the cooling tower is released to ambient air.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
6.1	Cooling tower blow down and cleaning water (w/biocide) that does not contain accelerator-produced radionuclides above analytical detection limits (MDL).	Non-hazardous effluent as determined by process knowledge/radiological testing	Wastewater is discharged to the storm system (outfall 002, recharge HN).	None
6.2	Emission from cooling tower containing tritiated water vapor and several other short half-life radionuclides (w/biocide)	Non-hazardous radioactive air emission below NESHAP level requiring continuous monitoring.	Vapors are released to ambient air. Release is within permissible levels.	None

7.0 Experimental System and Cooling Tower No. 4 (Bldg. 912A)

THIS SYSTEM IS NOT OPERATIONAL – Magnets and Power Supplies have been removed and the Cooling Tower has been dismantled.

Experimental system No. 4, located in Building 912A, is utilized to cool magnets and power supplies for the experimental beam lines (refer to process flow diagram AGS-004-CWS-07). Although the experimental cooling system is exposed to the beam, the system is only slightly activated due in part to the large volume of make-up water required to keep the cooling water conductivity within acceptable values. The cooling water in this system contains activation products but at concentrations below the drinking water standard and below the MDL. The primary cooling water system is an open system that transfers heat directly from the experimental magnets and power supplies to the cooling water and then rejects the heat directly to air utilizing a cooling tower. Cooling Tower No. 4 is located north of Building 912A. Make-up water for the cooling system is supplied by the BNL potable water system and added to the cooling system prior to the cooling tower. Biocide is also added to the cooling water prior to entering the cooling tower. Cooling tower blow down and cleaning water is discharged to the storm system (outfall 002, recharge HN). Water vapor from the cooling tower is released to ambient air. The experimental system includes two inline strainers that were utilized to trap

debris from the wood cooling tower. Experimental system No. 4 also utilizes a steam converter as part of the primary system, as required. Steam condensate from the converter is returned to the BNL steam plant as part of a closed loop system.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
7.1	Cooling tower blow down and cleaning water (w/biocide) that does not contain accelerator produced radionuclides above analytical detection limits (MDL).	Non-hazardous effluent as determined by process knowledge/radiological testing	Wastewater is discharged to the storm system (outfall 002, recharge HN)	None
7.2	Emission from cooling tower containing tritiated water vapor and several other short half-life radionuclides (w/biocide)	Non-hazardous radioactive air emission below NESHAP level requiring continuous monitoring.	Vapors are released to ambient air. Release is within permissible levels.	None
7.3	Steam condensate	Non-hazardous/non-radioactive water as determined by process knowledge	Water is returned to the BNL steam plant as part of a closed loop system	None

8.0 Bldg. 944 Test System and Bldg. 902 System/Cooling Tower

The Bldg. 944 test system and Bldg. 902 system/cooling tower are combined into one cooling water system (refer to process flow diagram AGS-004-CWS-08). The Bldg. 944 cooling system (primary system) is a closed loop system, which transfers heat from test magnets and power supplies (and the Bldg. 902 power supplies) to the cooling water. The Bldg. 944 cooling water then indirectly rejects the heat to the Bldg. 902 cooling tower water system utilizing a heat exchanger. The Bldg. 902 system (secondary system) is an open system, which transfers heat from the Bldg. 902 cryogenic compressor, test magnets and power supplies, and transfers heat indirectly from the Bldg. 944 cooling system utilizing a heat exchanger, to the Bldg. 902 cooling tower water. The Bldg. 902 cooling water then rejects the heat directly to air utilizing a cooling tower. Make-up water for the cooling systems is supplied by the BNL potable water system. Biocide, corrosion inhibitor and dispersant are added to the Bldg. 902 system prior to entering the cooling tower. Cooling tower blow down and cleaning water is discharged to the sanitary system. Water vapor from the cooling tower is released to ambient air. The Bldg. 944 test system

has a polishing filter/deionizer loop in parallel with the heat load. The Bldg. 944 spent filter is discarded as trash approximately once per year and the spent deionizer-resins are drummed, sampled and disposed based on sample analysis results.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
8.1	Cooling tower blow down and cleaning water (w/chemicals)	Non-hazardous/non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the sanitary system (outfall 001F)	None
8.2	Water vapor from cooling tower (w/chemicals)	Non-hazardous/non-radioactive vapors as determined by process knowledge	Vapors are released to ambient air	None
8.3	Polishing bag filter	Non-hazardous/non-radioactive solid waste as determined by process knowledge	Waste is discarded in the trash	None
8.4	Polishing deionizer resin	Non-hazardous/non-radioactive solid waste as determined by process knowledge	Spent resin is removed and transported off-site for disposal.	None

9.0 AGS Rectifier System, RF Power System, Choke, RF Cavity System, Chilled Water System and RFMG Tower (Bldgs. 928/929)

The AGS RFMG cooling water systems consists of several primary closed loop systems that share a secondary open cooling system, and the RFMG Cooling tower (refer to process flow diagram AGS-004-CWS-09). The primary systems that transfer heat (via heat exchangers) to the RFMG Cooling Tower secondary system include the AGS rectifier system, AGS RF Power Supply system, AGS Choke system, the AGS Rheostat system, the AGS Siemens MG Set and the two Chillers (on the Chilled Water System).

The Chilled Water System is a closed loop system that provides cooling for the Bldg 928 Control Room Air Handler, the Bldg 928 RF Power Supply Air Handler, the Bldg 929 Office Air Handler, the Siemens MG Set Oil Cooler and the AGS RF Cavity system (located in Buildings 912, 913, 928 and 929). The Chilled Water System, operated by BNL Plant Engineering rejects heat to two chillers, which in turn rejects heat to the RFMG Cooling Tower.

The RF cavity system is an activated cooling water system. Water drained or otherwise collected from the primary loop is collected in tanker trailers where it is stored for reuse/recycle, or evaporated or disposed of as radioactive waste. Make-up water for the all of the cooling water systems is supplied by the BNL potable water system. Biocide, corrosion inhibitor and

dispersant are added to the RFMG secondary cooling water loop prior to entering the cooling tower. Cooling tower blow down and cleaning water is discharged to the storm system (outfall 002, recharge HN). Water vapor from the cooling tower is released to ambient air. Cooling water within the primary closed loop systems is routed through polishing deionizers. The primary systems also share a common BNL potable water make-up deionizer. The spent make-up deionizer resins and polishing resins are exchanged on-site approximately every 2 years and the resins are used as fill in the low-level radioactive waste containers.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
9.1	RF Cavity Cooling Water (primary)	Non-hazardous/ radioactive water as determined by process knowledge	Water that is collected in tankers is not initially waste and can be recycled. Liquid waste, if any, is disposed of as radioactive waste.	None
9.2	Cooling tower blow down and cleaning water (w/chemicals)	Non-hazardous/ non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the storm system (outfall 002, recharge HN)	None
9.3	Water vapor from cooling tower (w/chemicals)	Non-hazardous/ non-radioactive vapors as determined by process knowledge	Vapors are released to ambient air	None
9.4	Rectifier system polishing resin	Non-hazardous/ non-radioactive solid waste as determined by process knowledge	Spent polishing resin is removed and transported off-site for disposal.	None
9.5	RF power system polishing resin	Non-hazardous/ non-radioactive solid waste as determined by process knowledge	Spent polishing resin is removed and transported off-site for disposal.	None
9.6	Choke system polishing resin	Non-hazardous/ non-radioactive solid waste as determined by process knowledge	Spent polishing resin is removed and transported off-site for disposal.	None

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
9.7	RF cavity system polishing resin	Non-hazardous/ radioactive solid waste as determined by process knowledge/ radioactivity survey	Spent polishing resin is removed and transported off-site for disposal.	None
9.8	Make-up deionizer-resin. (potable water)	Non-hazardous/ non-radioactive solid waste as determined by process knowledge	Spent deionizer resin is removed and transported off-site for disposal.	None

10.0 LINAC RF Cavity System, Transport Water System, RF Power System and Chilled Water System/Cooling Tower (Bldg. 930)

The Linac cooling water system consists of several primary closed loop systems that transfer heat to the Linac Cooling Tower System (a secondary cooling system) or to the Linac Chilled Water System (a secondary system that transfers its heat to the cooling tower system, refer to process flow diagram AGS-004-CWS-10). The Linac RF Cavity system, Linac Transport system, RF Power system, the EBIS system, and the OPPIS system, located in Buildings 930 and 930B, are the primary cooling water loops. The cooling water from the primary systems of the Linac RF Cavity and Linac Transport System transfer heat via heat exchangers to the Linac Chilled Water System. The Chilled Water System, maintained and operated by BNL Plant Engineering Division, transfers its heat to the Linac Cooling Tower system. The cooling water from the primary system of the Linac RF Power system transfers heat via a heat exchanger directly to the Linac Cooling Tower system.

The Linac Transport system and RF Cavities 3, 4 & 5 are the only activated Linac cooling water loops. Water drained or otherwise collected from the primary loop is collected in tanker trailers where it is stored for reuse/recycle, or evaporated or disposed of as radioactive waste. Make-up water for all the cooling systems is supplied by the BNL potable water system. Biocide, corrosion inhibitor and dispersant are added to the Cooling Tower loop prior to entering the cooling tower. Cooling tower blow down and cleaning water is discharged to the storm system (outfall 006A, recharge HT West). Water vapor from the cooling tower is released to ambient air.

The RF cavity cooling system has inline filters and corrosion inhibitor that are added to the closed loop system to minimize corrosion from the steel piping. The inline filters are discarded as trash approximately once a year. The transport and RF power cooling systems share a common make-up deionizer. The spent make-up deionizer resin is exchanged on-site approximately every 2 years and the resins are drummed, sampled and disposed based on sample analysis results. The transport and RF power cooling systems have separate polishing deionizers as the transport system is activated and the RF power system is not. The RF power-system deionizer resin is exchanged on-site approximately every 2 years and the resins are drummed,

sampled and disposed based on sample analysis results. The transport system polishing deionizer resin is exchanged on-site and the resin is used as fill in the low-level radioactive waste containers. The Linac Cooling Tower loop includes an inline strainer to trap debris from the wood cooling tower. This system also utilizes a steam converter as part of the secondary system, as required. Steam condensate from the converter is discharged directly into the cooling tower.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
10.1	Cooling tower blow down and cleaning water (w/chemicals)	Non-hazardous/non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the storm system (outfall 006A, recharge HT West)	None
10.2	Water vapor from cooling tower (w/chemicals)	Non-hazardous/non-radioactive vapors as determined by process knowledge	Vapors are released to ambient air	None
10.3	RF cavity system, EBIS system, OPPIS system inline bag filters	Non-hazardous/non-radioactive solid waste as determined by process knowledge	Waste is discarded as trash	None
10.4	Make-up deionizer resin (potable water)	Non-hazardous/non-radioactive solid waste as determined by process knowledge	Spent deionizer resin is removed and transported off-site for disposal.	None
10.5	RF power system polishing deionizer resin	Non-hazardous/non-radioactive solid waste as determined by process knowledge	Spent polishing resin is removed and transported off-site for disposal.	None
10.6	Transport system polishing deionizer resin	Non-hazardous/radioactive solid waste as determined by process knowledge/radioactivity survey	Spent polishing resin is removed and transported off-site for disposal.	None
10.7	Converter steam condensate	Non-hazardous/non-radioactive water as determined by process knowledge	Water is discharged directly into the cooling tower.	None

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
10.8	LINAC Transport System Cooling Water (primary)	Non-hazardous/ radioactive water as determined by process knowledge	Water that is collected in tankers is not initially waste and can be recycled. Liquid waste, if any, is disposed of as radioactive waste.	None

11.0 10th Station System (Bldg. 930)

The 10th station cooling water system, located in Building 930, is utilized during the testing of power supplies (refer to process flow diagram AGS-004-CWS-11). The primary cooling water system is a closed loop system that transfers heat from the power supplies to the cooling water. Heat from the cooling water is indirectly rejected to domestic water utilizing a heat exchanger. Make-up water for the primary loop and heat exchanger is supplied by the BNL potable water system. Water from the heat exchanger is discharged to the storm system (outfall 006A, recharge HT West). The 10th station system has one deionizer that is utilized for both make-up water and polishing. Spent deionizer resin is exchanged on-site and the resins are drummed, sampled and disposed based on sample analysis results.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
11.1	Water from secondary side of the 10 th station heat exchanger	Non-hazardous/ non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the storm system (outfall 006A, recharge HT West)	None
11.2	Make-up/polishing deionizer resin	Non-hazardous/ non-radioactive solid waste as determined by process knowledge	Spent polishing resin is removed and transported off-site for disposal.	None

12.0 Beam Stop (BLIP System) (Bldg. 930, 946)

The beam stop (BLIP system) cooling water system, located in Building 930, cools the beam stops and blip magnets (refer to process flow diagram AGS-004-CWS-12). The primary cooling water system is a closed loop system that transfers heat from the beam stops and blip magnets to the cooling water. Heat from the cooling water is indirectly rejected to the secondary system, domestic water utilizing a heat exchanger. Due to exposure to the beam, the primary loop

cooling water becomes activated. Water drained or otherwise collected from the primary loop is collected in tanker trailers where it is stored for reuse/recycle, or evaporated or disposed of as radioactive waste. Make-up water for the primary loop and heat exchanger is supplied by the BNL potable water system. Water from the secondary side of the heat exchanger is discharged to the storm system (outfall 006A, recharge HT West). The beam stop (blip system) cooling system has one deionizer that is utilized for polishing primary cooling water. A filter is located before the deionizer within the polishing loop of the primary cooling water system. Spent filter bags are sent off-site and disposed of as low level radioactive waste approximately once a year. Spent deionizer resin is exchanged on-site and resins are drummed, sampled and disposed based on sample analysis results.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
12.1	Water from the secondary side beam stop (blip system) heat exchanger	Non-hazardous/ non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the storm system (outfall 006A, recharge HT West)	None
12.2	Polishing bag filter	Non-hazardous/ radioactive solid waste as determined by process knowledge/ radioactivity survey	Waste is sent off-site for disposal as low level radioactive waste	None
12.3	Polishing deionizer resin	Non-hazardous/ radioactive solid waste as determined by process knowledge/ radioactivity survey	Spent polishing resin is removed and transported off-site for disposal.	None
12.4	Beam Stop Cooling Water (primary)	Non-hazardous/ radioactive water as determined by process knowledge	Water that is collected in tankers is not initially waste and can be recycled. Liquid waste, if any, is disposed of as radioactive waste.	None

13.0 Booster Magnet System and Cooling Tower No. 5

The Booster magnet system and Cooling Tower No. 5, which are located in Buildings 914 and 919, consist of a primary closed-loop system, heat-exchanger and secondary open system with a cooling tower (refer to process flow diagram AGS-004-CWS-13). The Building 919 compressor and Power Supply system is inactive and has been drained. The booster magnet cooling system (primary system) is a closed loop system that transfers heat from booster magnets, power amplifiers and power supplies to the cooling water. The booster magnet system cooling water then indirectly rejects the heat to the Cooling Tower No. 5 water system (secondary system) utilizing a heat exchanger. The Cooling Tower No. 5 system (secondary system) is an open system, which transfers heat from the Bldg. 919 compressors and indirectly transfers heat from the booster magnet cooling system via the heat exchanger to the cooling water. The cooling water then rejects the heat directly to air utilizing Cooling Tower No. 5. Cooling Tower No. 5 is located by Building 919. The booster magnet cooling system is activated due to exposure to the beam. Water drained or otherwise collected from the primary loop is collected in tanker trailers where it is stored for reuse/recycle, or evaporated or disposed of as radioactive waste. Make-up water for the cooling systems is supplied by the BNL potable water system. Biocide, corrosion inhibitor and dispersant are added to the Cooling Tower No. 5 system prior to entering the cooling tower. Cooling tower blow down and cleaning water is discharged to the storm system (outfall 006B, recharge HT East). Water vapor from the cooling tower is released to ambient air. The Booster magnet system has a combined make-up water and polishing filter/deionizer loop. The spent filter is sent off-site for disposal as low-level radioactive waste approximately every 1 to 2 years. Spent deionizer resin is exchanged on-site approximately every two years and the resins are drummed, sampled and disposed based on sample analysis results.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
13.1	Cooling tower blow down and cleaning water (w/chemicals)	Non-hazardous/non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the storm system (outfall 006B, recharge HT East)	None
13.2	Water vapor from cooling tower (w/chemicals)	Non-hazardous/non-radioactive vapors as determined by process knowledge	Vapors are released to ambient air	None
13.3	Make-up/polishing bag filter	Non-hazardous/radioactive solid waste as determined by process knowledge/radioactivity survey	Waste is sent off-site for disposal as low level radioactive waste	None

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
13.4	Make-up/polishing deionizer resin	Non-hazardous/ radioactive solid waste as determined by process knowledge/ radioactivity survey	Spent polishing resin is removed and transported off-site for disposal.	None
13.5	Booster Magnet Cooling Water (primary)	Non-hazardous/ radioactive water as determined by process knowledge	Water that is collected in tankers is not initially waste and can be recycled. Liquid waste, if any, is disposed of as radioactive waste.	None

14.0 Booster RF Cavity System and Chilled Water/Cooling Tower System (Bldgs. 914/911)

The Booster RF cavity system, located in Bldg. 914, and the Bldg. 911 chilled water system/cooling tower are combined into one cooling water system (refer to process flow diagram AGS-004-CWS-14). The Booster RF cavity system (primary system) is a closed loop system, which transfers heat from the booster RF cavities to the cooling water and then indirectly rejects the heat utilizing a heat exchanger to the Bldg. 911 chilled water system. The Bldg. 911 chilled water system/cooling tower (secondary system) consists of a closed loop which transfers heat from the booster RF cavity heat exchanger, AGS fan house and Bldgs. 911 and 914 air conditioning systems to the chilled water. The chilled water then rejects the heat via a chiller to the Bldg. 911 cooling tower system, which is an open system. Cooling water from the Bldg. 911 cooling tower system directly rejects heat to air utilizing the cooling tower. The booster RF cavity system and closed loop of the Bldg. 911 chilled water system are activated due to exposure to the beam. Water drained or otherwise collected from the primary loop is collected in tanker trailers where it is stored for reuse/recycle, or evaporated or disposed of as radioactive waste. Make-up water for the cooling systems is supplied by the BNL potable water system. Biocide and corrosion inhibitor are added to the Bldg. 911 chilled water system and the system has a bag filter. Biocide, corrosion inhibitor and dispersant are added to the Bldg. 911 cooling tower system prior to entering the cooling tower. Cooling tower blow down and cleaning water is discharged to the storm system (outfall 002, recharge HN). Water vapor from the cooling tower is released to ambient air. The booster RF cavity system has combined make-up water and

polishing filter/deionizer loop. The booster RF cavity system spent filters are sent off-site for disposal as low-level radioactive waste approximately every 1 to 2 years. Spent deionizer resin is exchanged on-site approximately every two years and the resins are drummed, sampled and disposed based on sample analysis results.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
14.1	Cooling tower blow down and cleaning water (w/chemicals)	Non-hazardous/non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the storm system (outfall 002, recharge HN)	None
14.2	Water vapor from cooling tower (w/chemicals)	Non-hazardous/non-radioactive vapors as determined by process knowledge	Vapors are released to ambient air	None
14.3	Make-up/polishing bag filter	Non-hazardous/radioactive solid waste as determined by process knowledge/radioactivity survey	Waste is sent off-site for disposal as low level radioactive waste	None
14.4	Make-up/polishing deionizer resin	Non-hazardous/radioactive solid waste as determined by process knowledge/radioactivity survey	Spent resin is removed and transported off-site for disposal.	None
14.5	911 Chilled Water System bag filter	Non-hazardous/radioactive solid waste as determined by process knowledge/radioactivity survey	Waste is sent off-site for disposal as low level radioactive waste	None
14.6	Booster RF Cavity Cooling Water (primary)	Non-hazardous/radioactive water as determined by process knowledge	Water that is collected in tankers is not initially waste and can be recycled. Liquid waste, if any, is disposed of as radioactive waste.	None

15.0 Bldg. 919B Test System

The Bldg. 919B test system is utilized to cool test magnets (refer to process flow diagram AGS-004-CWS-15). The primary cooling water system is a closed loop system that transfers heat from the test magnets to the cooling water. Heat from the cooling water is then indirectly rejected to domestic water utilizing a heat exchanger. Make-up water for the primary loop and heat exchanger is supplied by the BNL potable water system. Water from the heat exchanger is discharged to the storm system (outfall 006B, recharge HT East). The system has a bag filter.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
15.1	Water from the Bldg. 919B test system heat exchanger	Non-hazardous/non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the storm system (outfall 006B, recharge HT East)	None
15.2	Bldg. 919B inline bag filter	Non-hazardous/non-radioactive solid waste as determined by process knowledge	Waste is discarded as trash	None

16.0 Bldg. 925 Test System

The Bldg. 925 test system is utilized to cool test RF power supplies and power amplifiers (refer to process flow diagram AGS-004-CWS-16). The primary cooling water system is a closed loop system that transfers heat from the test power supplies and power amplifiers to the cooling water. Heat from the cooling water is indirectly rejected to domestic water utilizing a heat exchanger. Make-up water for the primary loop and heat exchanger is supplied by the BNL potable water system. Water from the heat exchanger is discharged to the BNL sanitary sewer system (as no storm systems are near the Bldg. 925 test system). The Bldg. 925 test system has a polishing filter/deionizer loop that bypasses the heat load. Spent polishing filters are discarded in the trash approximately once a year. Spent polishing deionizer resin is exchanged on-site approximately every two years and the resins are drummed, sampled and disposed based on sample analysis results.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
16.1	Water from the Bldg. 925 test system heat exchanger	Non-hazardous/non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the BNL sanitary sewer system	None

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
16.2	Polishing bag filters	Non-hazardous/ non-radioactive solid waste as determined by process knowledge	Waste is discarded in the trash	None
16.3	Polishing deionizer resin	Non-hazardous/ non-radioactive solid waste as determined by process knowledge	Spent polishing resin is removed and transported off-site for disposal.	None

17.0 F10 House Cooling System (Bldg. 932)

The F10 house cooling system, located in Building 932, is utilized to cool the F10 house power supplies and bus (refer to process flow diagram AGS-004-CWS-17). The primary cooling water system is a closed loop system that transfers heat from the F10 power supplies and bus to the cooling water and then rejects the heat indirectly to air utilizing a fluid cooler (non-contact). The primary cooling system is activated due to exposure to the beam. Water drained or otherwise collected from the primary loop is collected in tanker trailers where it is stored for reuse/recycle, or evaporated or disposed of as radioactive waste. Make-up water for the cooling system and fluid cooler is supplied by the BNL potable water system. Fluid cooler blow down and cleaning water are discharged to the storm system (outfall 002, recharge HN). Water vapor from the fluid cooler is released to ambient air. The F10 house cooling system utilizes a polishing filter and deionizer. Spent polishing filter bags are surveyed for radioactivity and disposed of accordingly approximately once a year. Spent polishing deionizer resin is Spent deionizer resin is exchanged on-site approximately every two years and the resins are drummed, sampled and disposed based on sample analysis results.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
17.1	Fluid cooler blow down and cleaning water	Non-hazardous/ non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the storm system (outfall 002, recharge HN)	None
17.2	Water vapor from fluid cooler	Non-hazardous/ non-radioactive vapors as determined by process knowledge	Vapors are released to ambient air	None

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
17.3	Polishing bag filters	Non-hazardous/ radioactive or non- radioactive solid waste as determined by process knowledge/ radioactivity survey	If radioactive, sent off-site for disposal as low level radioactive waste; if non- radioactive discarded as trash	None
17.4	Polishing deionizer resin	Non-hazardous/ radioactive or non- radioactive solid waste as determined by process knowledge/ radioactivity survey	Spent polishing resin is removed and transported off-site for disposal.	None
17.5	F10 House Cooling Water (primary)	Non-hazardous/ radioactive water as determined by process knowledge	Water that is collected in tankers is not initially waste and can be recycled. Liquid waste, if any, is disposed of as radioactive waste.	None

18.0 Multipole Cooling System (Bldg. 911)

The multipole cooling system, located in Building 911, is utilized to cool multipole power supplies and test magnets (refer to process flow diagram AGS-004-CWS-18). The primary cooling water system is a closed loop system that transfers heat from the multipole power supplies and test magnets to the cooling water. Heat from the cooling water is then indirectly rejected to domestic water utilizing a heat exchanger. Make-up water for the primary loop and heat exchanger is typically supplied by the BNL potable water system. Potable water for the cooling has a temperature regulator and the water is fed into the system on an as need basis. However, the heat exchanger water supply system may also utilize a Westinghouse pump to pump and reuse process/domestic water from within the AGS Department. Water from the heat exchanger is discharged to the storm system (outfall 003ok, recharge HO). The multipole room cooling system has combined make-up water and polishing filter/deionizer loop. Spent make-up/polishing filters are discarded in the trash approximately once a year. Spent make-

up/polishing deionizer resin is exchanged on-site approximately every two years and the resins are drummed, sampled and disposed based on sample analysis results.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
18.1	Water from the multipole room cooling system heat exchanger	Non-hazardous/non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the storm system (outfall 002, recharge HN)	None
18.2	Spent bag filters	Non-hazardous/non-radioactive solid waste as determined by process knowledge	Waste is discarded in the trash	None
18.3	Make-up/polishing deionizer resin	Non-hazardous/non-radioactive solid waste as determined by process knowledge	Spent polishing resin is removed and transported off-site for disposal.	None

19.0 RF Power Amplifier (PA) Cooling System (Bldgs. 911/951)

The power amplifier (PA) cooling system, located in Building 911/951 Building, is utilized to cool Building 913 power amplifiers (refer to process flow diagram AGS-004-CWS-19). The primary cooling water system is a closed loop system, which transfers heat from the Building 913 power amplifiers via a heat exchanger to the cooling water and then rejects the heat indirectly to air utilizing a fluid cooler. The primary cooling system is activated due to exposure to the beam. Water drained or otherwise collected from the primary loop is collected in tanker trailers where it is stored for reuse/recycle, or evaporated or disposed of as radioactive waste. Make-up water for the cooling system and fluid cooler is supplied by the BNL potable water system. Fluid cooler blow down and cleaning water are discharged to the storm system (outfall 002, recharge HN). Water vapor from the fluid cooler is released to ambient air. The PA cooling system utilizes a make-up water deionizer that also feeds the polishing filter and deionizer. Spent polishing filter bags are sent off-site for disposal as low-level radioactive waste approximately once a year. Spent make-up water deionizer-resin and spent polishing deionizing-resin are exchanged on-site approximately every two years and the resins are drummed, sampled and disposed based on sample analysis results.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
19.1	Fluid cooler blow down and cleaning water	Non-hazardous/non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the storm system (outfall 002, recharge HN)	None

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
	Water vapor from fluid cooler	Non-hazardous/ non-radioactive vapors as determined by process knowledge	Vapors are released to ambient air	None
	Polishing bag filters	Non-hazardous/ radioactive solid waste as determined by process knowledge/ radioactivity survey	Waste is sent off-site for disposal as low level radioactive waste	None
	Make-up deionizer resin	Non-hazardous/ non-radioactive solid waste as determined by process knowledge	Spent deionizer resin is removed and transported off-site for disposal.	None
	Polishing deionizer resin	Non-hazardous/ radioactive solid waste as determined by process knowledge/ radioactivity survey	Spent deionizer resin is removed and transported off-site for disposal.	None
	Power Amp Cooling Water (primary)	Non-hazardous/ radioactive water as determined by process knowledge	Water that is collected in tankers is not initially waste and can be recycled. Liquid waste, if any, is disposed of as radioactive waste.	None

20.0 g-2 Cooling System and Tower (Bldg. 919) (Not in Service in FY03)

The g-2 cooling system and tower, located in Building 919, consists of a primary closed loop system, heat exchanger and secondary open system with a cooling tower (refer to process flow diagram AGS-004-CWS-20). The g-2 cooling system (primary system) is a closed loop system which transfers heat from g-2 magnets and the V-target via a heat exchanger to the cooling water and then indirectly rejects the heat to the g-2 cooling tower system (secondary system). The g-2 cooling tower system is an open system that then rejects the heat directly to air utilizing the g-2 cooling tower. The g-2 cooling system (primary) is activated due to exposure to the beam. Water drained or otherwise collected from the primary loop is collected in tanker trailers where it is stored for reuse/recycle, or evaporated or disposed of as radioactive waste. Make-up water for the cooling systems is supplied by the BNL potable water system. Biocide and other water treatment chemicals are added to the g-2 cooling tower system prior to entering the cooling tower. Cooling tower blow down and cleaning water is discharged to the storm system (outfall 006B, recharge HT East). Water vapor from the cooling tower is released to ambient air. The g-2 cooling system has a make-up water deionizer and polishing filter/deionizer loop in parallel with the heat load. The spent filter is sent off-site for disposal as low-level radioactive waste approximately every 1 to 2 years. The make-up deionizer resin is exchanged on-site approximately every two years and the resins are drummed, sampled and disposed based on sample analysis results.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
20.1	Cooling tower blow down and cleaning water (w/biocide)	Non-hazardous/ non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the storm system (outfall 006B, recharge HT East)	None
20.2	Emission from cooling tower containing tritiated water vapor and several other short half-life non- respirable radionuclides (w/biocide)	Non-hazardous radioactive air emission below NESHAP level requiring continuous monitoring	Vapors are released to ambient air. Release is within permissible levels	None
20.3	Polishing bag filters	Non-hazardous/ radioactive solid waste as determined by process knowledge/ radioactivity survey	Waste is sent off- site for disposal as low level radioactive waste	None

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
20.4	Make-up deionizer resin	Non-hazardous/ non-radioactive solid waste as determined by process knowledge	Spent deionizer resin is removed and transported off-site for disposal.	None
20.5	Polishing deionizer resin	Non-hazardous/ radioactive solid waste as determined by process knowledge/ radioactivity survey	Spent deionizer resin is removed and transported off-site for disposal.	None
20.6	g-2 Cooling Water (primary)	Non-hazardous/ radioactive water as determined by process knowledge	Water that is collected in tankers is not initially waste and can be recycled. Liquid waste, if any, is disposed of as radioactive waste.	None

21.0 Tandem Van de Graaff Ion Exchange System (Bldg. 901A)

The Tandem Van de Graaff cooling water ion exchange system is located in Bldg. 901. The ion exchange system is part of a closed loop cooling water system and is utilized for polishing cooling water for the Tandem Van de Graaff (refer to process flow diagram AGS-004-CWS-21). The ion exchange system consists of a bag filter and a deionizer. Make-up water for the cooling water system is supplied by the BNL potable water system. Spent filters are removed and sent off-site as hazardous waste approximately once every 18 months. Spent deionizer resin is exchanged on-site approximately every two years and the resins are drummed, sampled and disposed based on sample analysis results.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
21.1	Polishing bag filters	Non-hazardous/ non-radioactive solid waste as determined by process knowledge	Waste is sent off-site for disposal as hazardous waste	None
21.2	Polishing deionizer resin	Non-hazardous/ non-radioactive solid waste as determined by process knowledge	Spent deionizer resin is removed and transported off-site for disposal.	None

22.0 Special Experimental Magnet Cooling Water System and Cooling Tower

THE SEM SEM OF THE SYSTEM IS NOT OPERATIONAL – Magnets and Power Supplies have been removed and the Cooling Tower is shut down.

The Special Experimental Magnet System (SEM) supplies cooling water to magnet assemblies in Building 912, the AGS ring, the Warm Snake, and AtR Injection. The system consists of four pumps located in Bldg. 912A that circulate the primary coolant, a heat exchanger to transfer heat to the secondary cooling water system, and a de-ionizer. The secondary system contains two pumps, an ozone generating system to maintain chemistry control, and a dedicated cooling tower (refer to process flow diagram AGS-004-CWS-22).

The SEM cooling water system, because it is exposed to the beam lines, is tritiated to levels in excess of the drinking water standards (~0.6 $\mu\text{Ci/L}$) and contains very small amounts of other activation products in concentrations below drinking water standards. Water drained or otherwise collected from the primary loop is collected in tanker trailers where it is stored for reuse/recycle, or evaporated or disposed of as radioactive waste. Cooling water within the primary system is routed through a polishing deionizer. Spent deionizer resin is exchanged on-site approximately every two years and the resins are drummed, sampled and disposed based on sample analysis results. Make-up water is supplied by BNL potable water system, which also passes through a deionizer and these resins are exchanged on-site approximately every two years and the resins are drummed, sampled and disposed based on sample analysis results. The secondary cooling water receives heat from the primary system through a heat exchanger and dissipates it in a cooling tower. Chemical treatment has been replaced by use of an ozone generating system that assists in maintaining water quality. Cooling tower blow down and tower cleaning is discharged to the storm system (outfall 002, HN). Water vapor from the cooling tower is released to ambient outside air.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
	Cooling tower blow down and cleaning water (w/biocide)	Non-hazardous/non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the storm system (outfall 003, recharge HN)	None
	Emission from cooling tower	Non-hazardous, non-radioactive air emission	Vapors are released to ambient air.	None
	Polishing bag filters	Non-hazardous/radioactive solid waste as determined by process knowledge/radioactivity survey	Waste is sent off-site for disposal as low level radioactive waste	None

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
22.4	Polishing deionizer resin	Non-hazardous/ radioactive solid waste as determined by process knowledge/ radioactivity survey	Spent deionizer resin is removed and transported off-site for disposal.	None
22.5	SEM Water (primary)	Non-hazardous/ radioactive water as determined by process knowledge	Water that is collected in tankers is not initially waste and can be recycled. Liquid waste, if any, is disposed of as radioactive waste.	None

23.0 NASA Space Radiation Laboratory (NSRL)

The NSRL cooling water system, located in Buildings 930A, 956 and 957, is used to cool NSRL and Booster power supplies and NSRL magnets. The system consists of two primaries and one secondary loop. The secondary loop consists of a cooling tower with BNL potable water makeup. The tower water is treated with ozone instead of chemicals. Drains from the cooling tower go to the storm drains. The secondary water removes heat from two heat exchangers, the power supply exchanger and the NSRL magnet exchanger. Please refer to process flow diagram AGS-004-CWS-23.

The magnet heat exchanger removes the heat from the NSRL magnets located in the NSRL tunnel (Building 956). The supply and return lines pass from the pump room in Building 957 to the NSRL tunnel in Building 957 via underground pipes with secondary containment (~90 feet in length). While secondary containment is not needed (the water will never be activated to levels that will exceed the drinking water standards), it was added as a best management practice for this new facility.

The power supply heat exchanger removes heat from the NSRL power supplies and some of the power supplies previously supplied by the Linac (Building 930) RF cavity and Transport system. The Booster loads to be cooled by the NSRL power supply cooling system include the 930A Linac extension, 930 Upper Equipment Bay and other Booster power supplies. This change will reduce the volume of contaminated water because these booster loads are currently cooled by a water system that is tritiated. This change will also allow the Linac to run without running the NSRL cooling water and the Booster to run without running the Linac RF and Transport system, thus saving energy costs and allowing systems to be shutdown for maintenance without impacting the experimental program schedule. The supply and return lines from Building 957 to 930A are buried, single walled stainless steel pipe about 90 feet long. This water is not contaminated.

Each primary loop has an on-line deionizer and filtering system and a makeup deionizer. Filters and ion resins will be checked for radioactivity and hazardous materials to assure proper disposal. Spent deionizer resin will be exchanged on-site approximately every two years and the resins are drummed, sampled and disposed based on sample analysis results.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
23.1	Cooling tower blowdown and cleaning water (w/biocide)	Non-hazardous/ non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the STP through sanitary.	None
23.2	Water vapor emissions from cooling tower	Non-radioactive / process knowledge	Vapors are released to ambient air.	None
23.3	Polishing bag filters	Non-hazardous/ radioactive solid waste as determined by process knowledge/ radioactivity survey	Waste is sent off- site for disposal as low level radioactive waste	None
23.4	Make-up deionizer resin	Non-hazardous/ non-radioactive solid waste as determined by process knowledge	Spent deionizer resin is removed and transported off-site for disposal.	None
23.5	Activated cooling water (Below EPA Drinking Water Standard)	Radioactive / process knowledge, direct analysis	Water that is collected in storage tankers is not waste and can be recycled. Liquid waste, if any, is disposed of as radioactive waste.	None
23.6	Power Supply waste water	Non-hazardous/ non-radioactive liquid waste as determined through direct analysis	If water samples are non- radioactive then water may be disposed of via BNL storm system	None

24.0 Water Storage Tankers

Radioactive water drained or collected from the various radioactive cooling water systems is transferred to one of three 7,000-gallon tanker trailers. These tanks, usually located south of Bldg. 919 can be moved by truck throughout the site to facilitate transferring of wastewater. The tankers are constructed of stainless steel and are parked within secondary containments when not being used to transfer water.

Steam or electric heat can be supplied to the tankers to slowly heat the wastewater and evaporate it. The vapor contains tritium from the activated cooling water systems. The emissions have been assessed against NESHAPS requirements and radiation dose rates are well below levels that require continuous monitoring. DOE-BAO has reviewed the evaporation process and given the C-A Department approval to perform the operation as required. Tanker water may be reused/recycled or evaporated.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
24.1	Tritiated water collected from activated cooling water systems	Non-hazardous/ radioactive liquid waste as determined by process knowledge	Water that is collected in tankers is not initially waste and can be recycled. Liquid waste, if any, is disposed of as radioactive waste.	None

25.0 Energy Recovery LINAC (ERL)

An Energy Recovery LINAC is currently under construction in NEBA portion of building 912. This is an R&D ERL built in order to verify the design of what will be built for the RHIC Accelerator as part of the e-Cooling Project that is under design within the Collider-Accelerator Department. This machine will have a maximum energy of 22 MeV and will support a beam current of 0.5 Amperes. The ERL will use a diamond amplified photocathode in a high-current RF gun to produce an ultra-stable 703.75 MHz frequency through the 5-cell superconducting ERL cavity. The function of the ERL will be to allow the injection of electrons into the RHIC ring to counteract beam debunching. This will ultimately create a significantly higher rate of luminosity at collision.

The ERL system, located in Bldg. 912 (refer to process flow diagram AGS-004-CWS-25) is a closed loop system, which transfers heat from the ERL magnets and cryogenic compressors to the cooling water and then indirectly rejects the heat utilizing a heat exchanger to Cooling Tower #3. Cooling water from tower #3 directly rejects heat to air utilizing the cooling tower. Water drained or otherwise collected from the ERL primary loop is collected in tanker trailers where it is stored for reuse/recycle, or evaporated or disposed of as radioactive waste. Make-up water for

the cooling systems is supplied by the BNL potable water system. No biocide or corrosion inhibitors are added to the ERL water system and the system has a bag filter. Cooling tower blow down is discharged to the storm system (outfall 002, recharge HN). Water vapor from the cooling tower is released to ambient air. The ERL system has a make-up water and deionizer loop. The ERL system spent filters will be sent off-site for disposal as low-level radioactive waste approximately every 1 to 2 years. Spent deionizer resin is exchanged on-site approximately every two years and the resins are drummed, sampled and disposed based on sample analysis results.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
25.1	Cooling tower blowdown and cleaning water (w/biocide)	Non-hazardous/ non-radioactive effluent as determined by process knowledge	Wastewater is discharged to the STP through sanitary.	None
25.2	Water vapor emissions from cooling tower	Non-radioactive / process knowledge	Vapors are released to ambient air.	None
25.3	Polishing bag filters	Non-hazardous/ radioactive solid waste as determined by process knowledge/ radioactivity survey	Waste is sent off- site for disposal as low level radioactive waste	None
25.4	Make-up deionizer resin	Non-hazardous/ non-radioactive solid waste as determined by process knowledge	Spent deionizer resin is removed and transported off-site for disposal.	None
25.5	Activated cooling water (Below EPA Drinking Water Standard)	Radioactive / process knowledge, direct analysis	Water that is collected in storage tankers is not waste and can be recycled. Liquid waste, if any, is disposed of as radioactive waste.	None

III. Waste Minimization, Opportunities for Pollution Prevention

Various Cooling Towers – Chemical Addition

BNL is currently evaluating the use of alternate chemicals and non-chemical systems for maintaining cooling tower water. The non-chemical, ozone systems are installed at the PHOBOS and BRAHMS experiments at the RHIC, the RHIC RF system and at the SEM and NSRL systems at AGS. These systems utilize a magnetic energy inducer to increase water solubility and inhibit scale formation, followed by an ozone disinfecting system. These systems are currently under evaluation for their effectiveness. The ozone treatment system eliminates the use of chemicals for cooling tower water treatment. It is important to note that ozone is a SARA Title III TRI chemical; therefore, the manufacture of ozone would need to be included in the BNL TRI threshold determination/report.

IV. Assessment Prevention and Control

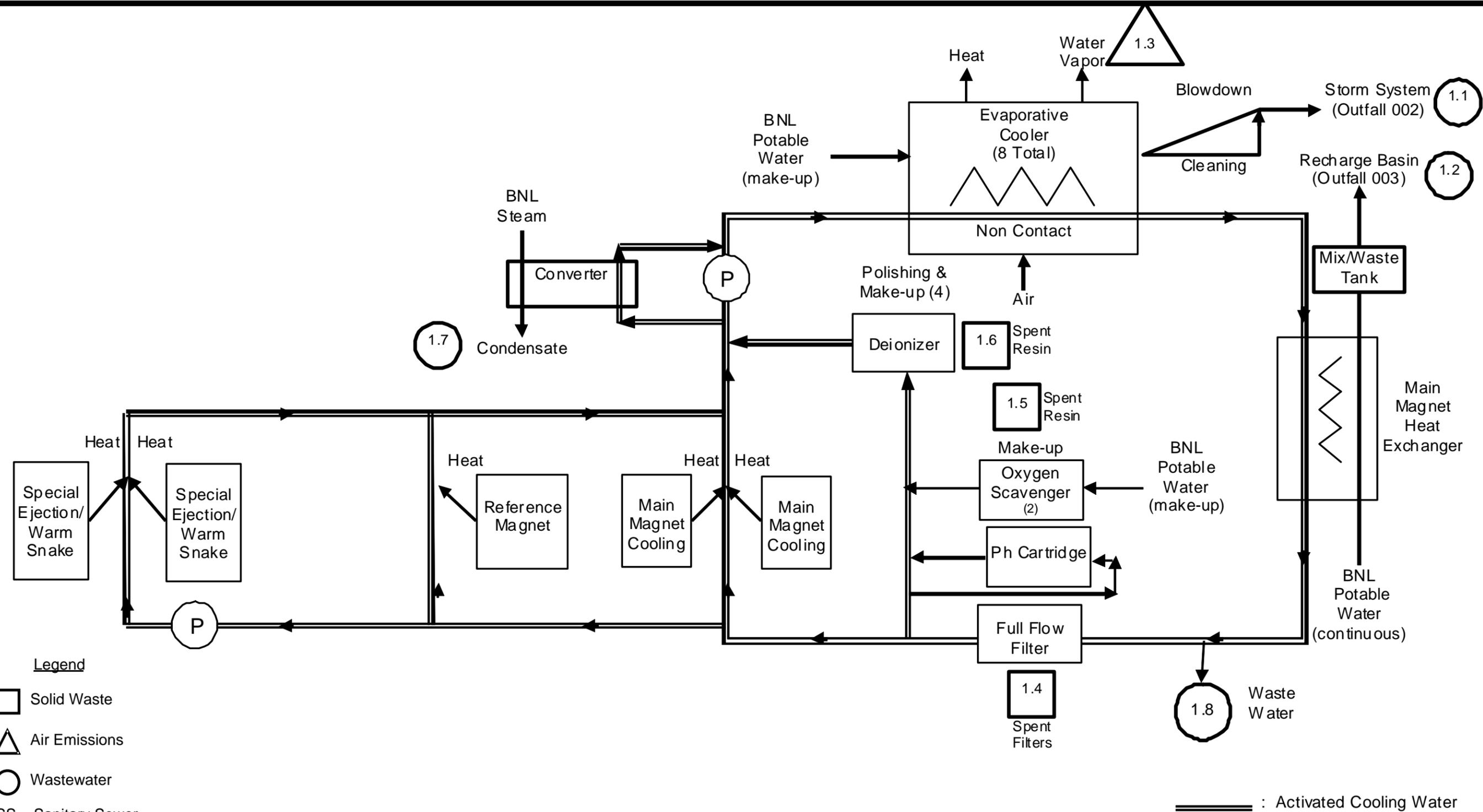
Activated Cooling Water Systems – Underground Cooling Water Piping Leak Detection

Suffolk County Department of Health Services Article 12 standards apply to piping systems that contain radioactive concentrations above drinking water standards. Very few of the buried piping within AGS contains water with radioactive concentrations that exceed the drinking water standard. The C-A Department actively monitors activated cooling water systems for leaks utilizing fluid level measurements and records of the volume of make-up water added to the system. The AGS underground activated cooling water piping does not have secondary containment, however the installation of secondary containment for this piping may not be feasible due to the large extent of underground piping. Regardless, secondary containment for underground-activated cooling water piping should be evaluated, in particular, for older, high use and high risk activated cooling water systems. Secondary containment for the RHIC cooling water system piping should also be considered during the initial phases of the project.

More practically, the water in the cooling water systems could be monitored and replaced at specific intervals to eliminate the radioactive component and maintaining the piping systems exempt from containment requirements.

Prevention Assessment and Control Initiatives		
Process ID	Waste Stream ID	SOP, Inspection or other APC Measures Recommended
AGS	Activated Cooling Water	Evaluate underground activated cooling water piping for secondary containment.
AGS	Activated Cooling Water	Monitor radioactive concentrations and replace with clean water periodically to maintain concentrations below drinking water standards.

ATTACHMENT 1
PROCESS FLOW DIAGRAMS



Legend

- Solid Waste
- △ Air Emissions
- Wastewater

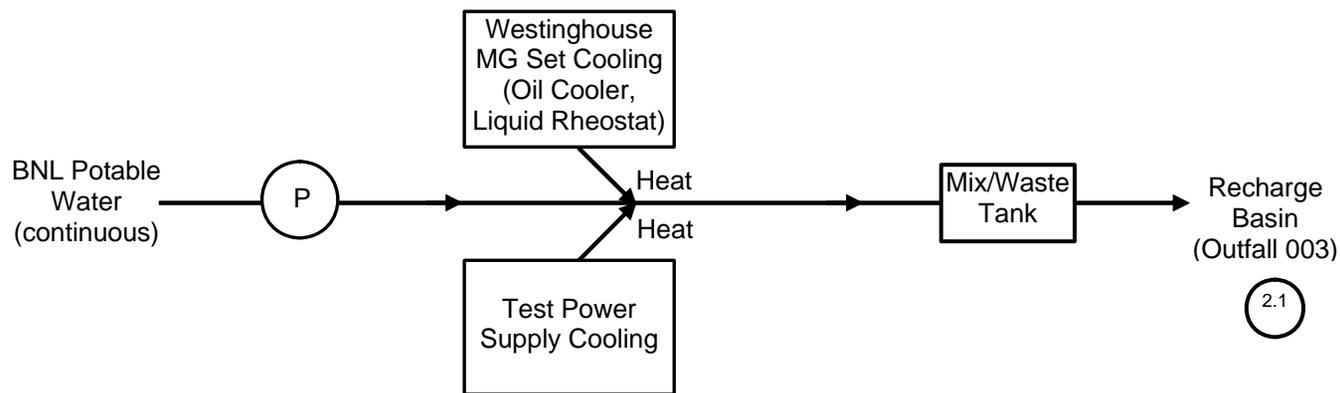
SS = Sanitary Sewer

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CWS04D-072007T

BROOKHAVEN NATIONAL LABORATORY
PROCESS ASSESSMENT PROGRAM

**Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram – Main Magnet System (Bldgs. 911/913)**

AGS-004-CWS-01



Legend

- Solid Waste
- △ Air Emissions
- Wastewater
- SS = Sanitary Sewer
- Ⓟ Pump(s)

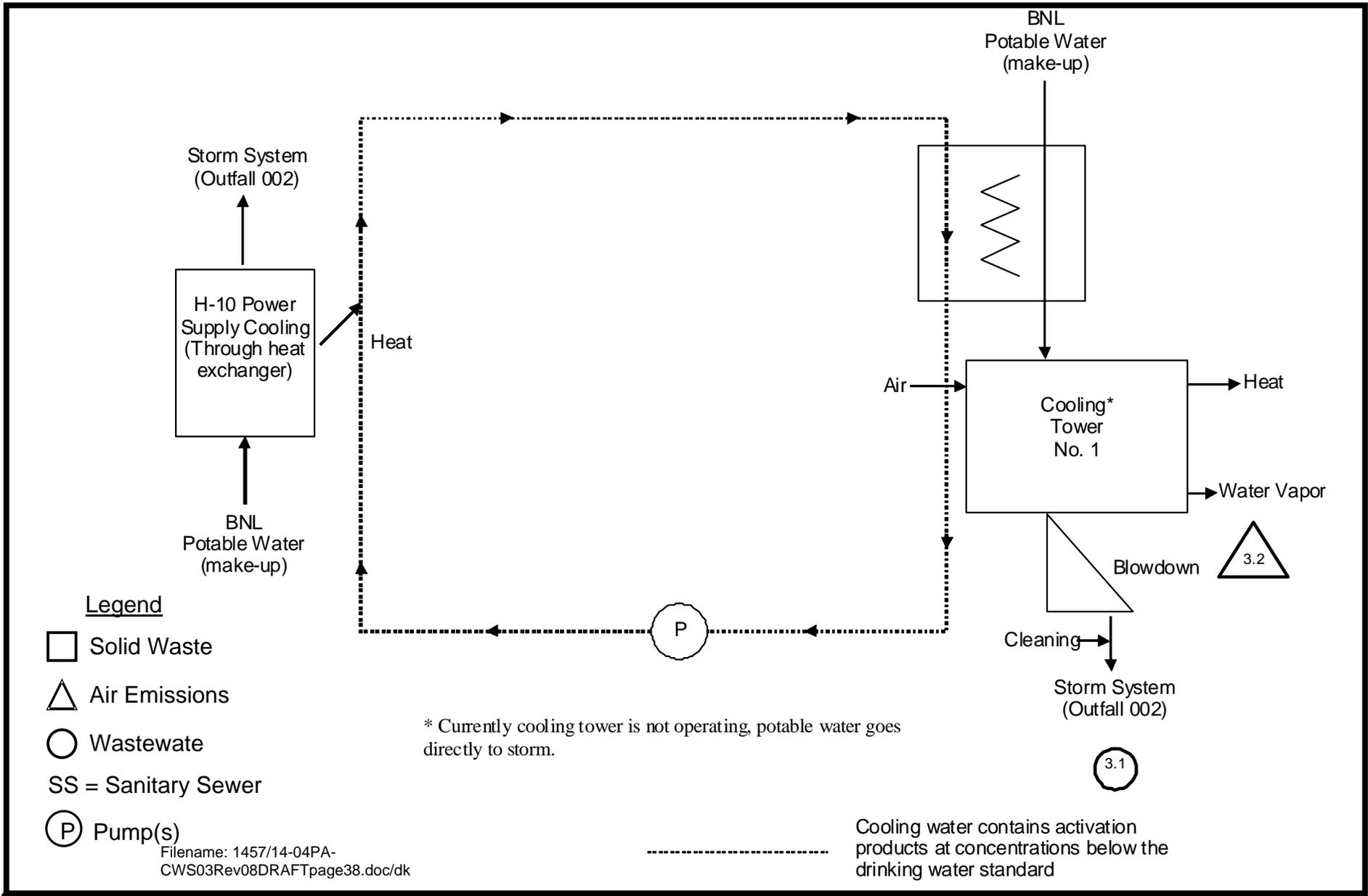
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Note: Additional loads may be added as part of system upgrade.

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PROCESS ASSESSMENT PROGRAM

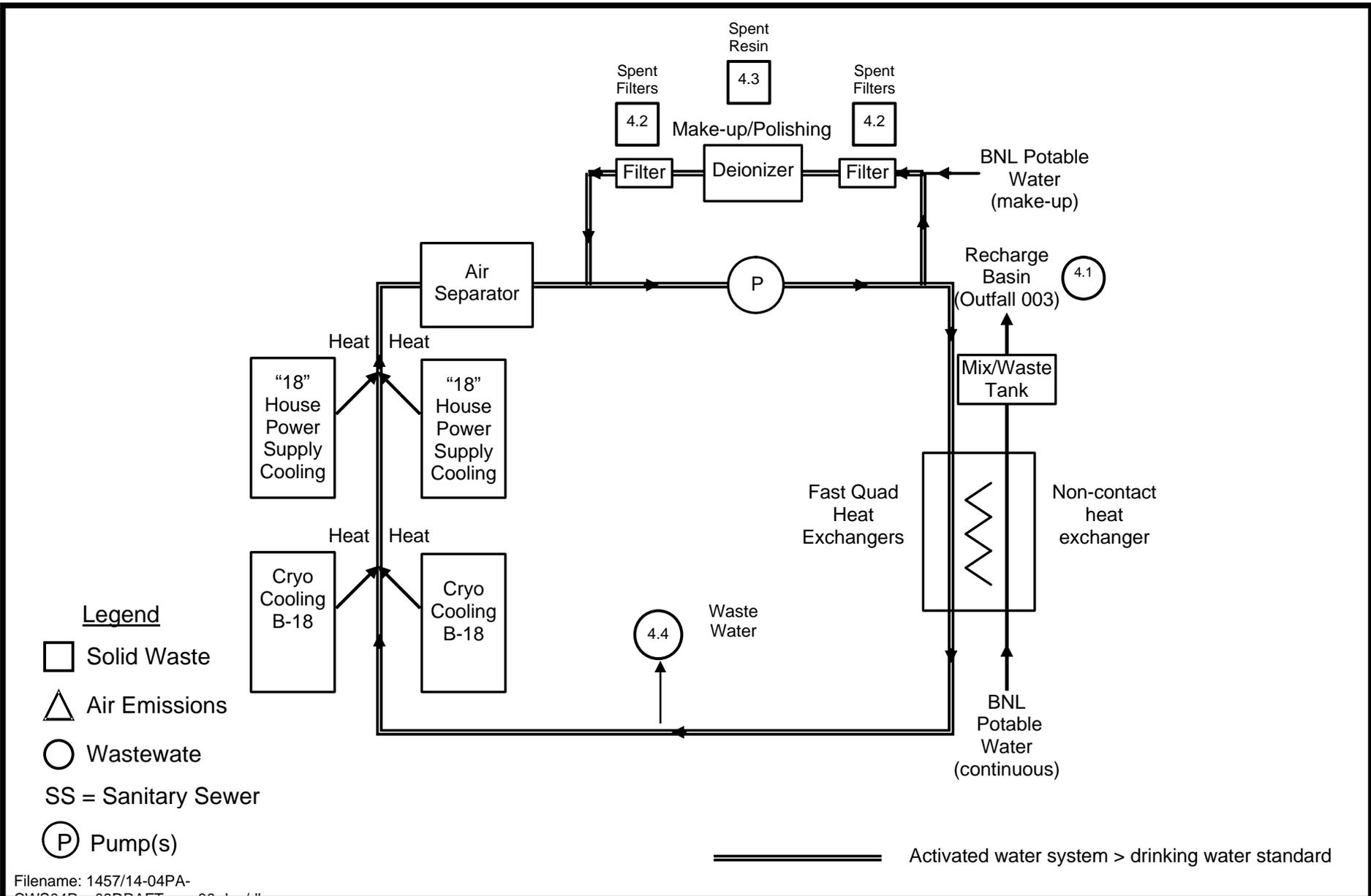
**Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram – Westinghouse System (Bldg. 911)**

AGS-004-CWS-02

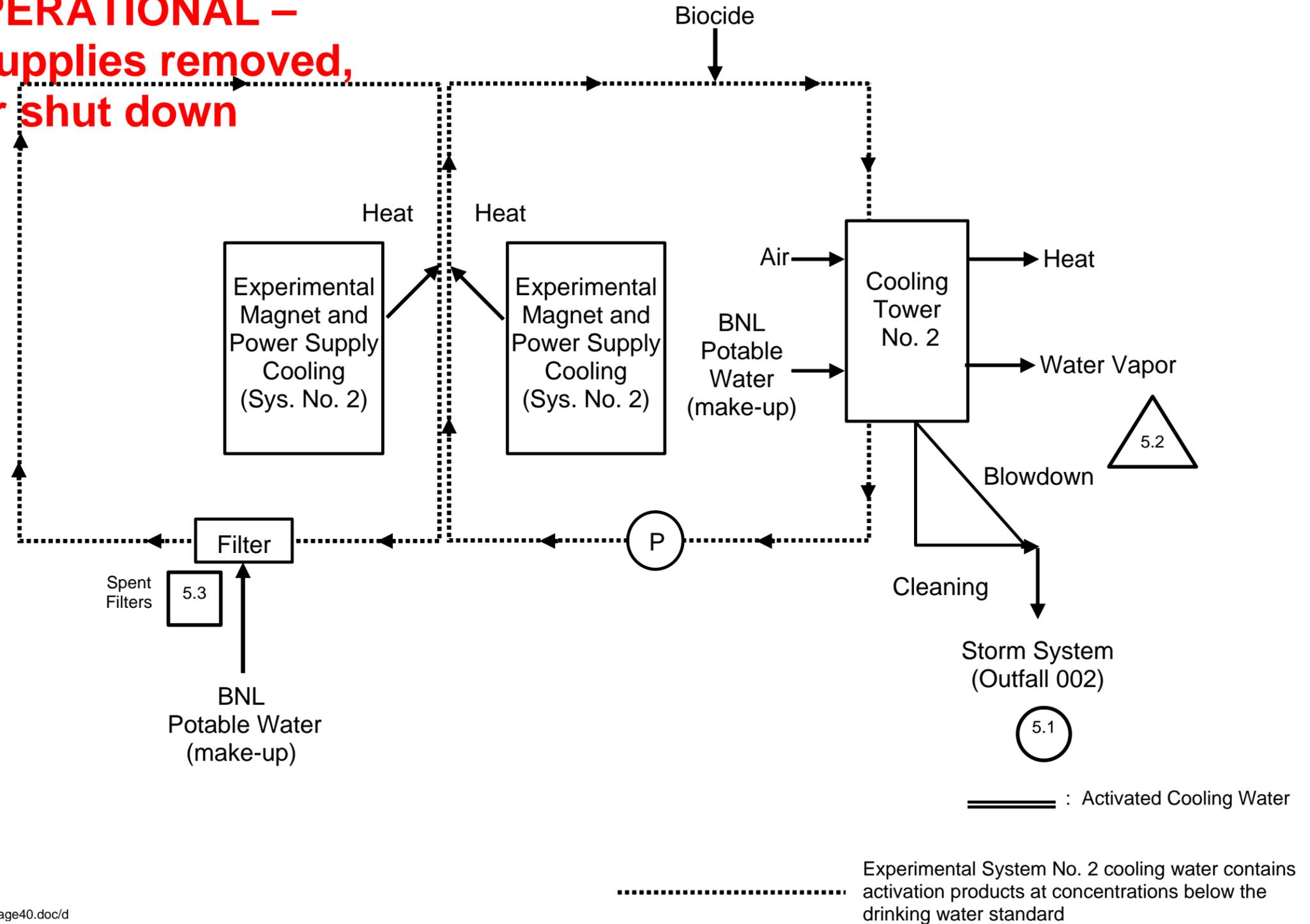


BROOKHAVEN NATIONAL LABORATORY
 PROCESS ASSESSMENT PROGRAM
Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram – Experimental System, H-10, and Cooling Tower No. 1
(Bldgs. 911/912)

AGS-004-CWS-03

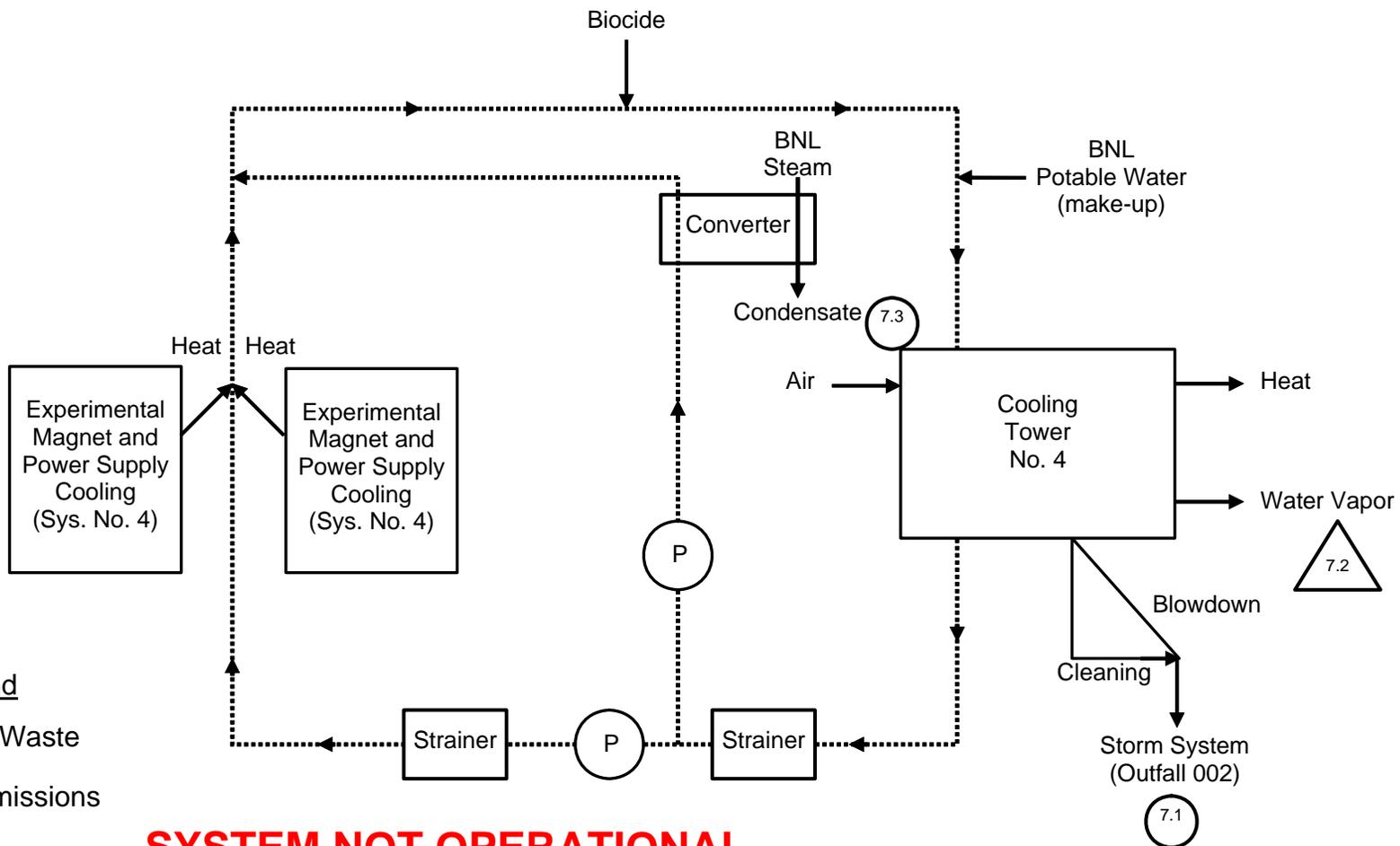


**SYSTEM NOT OPERATIONAL –
Magnets & Power Supplies removed,
Cooling Tower shut down**



BROOKHAVEN NATIONAL LABORATORY
PROCESS ASSESSMENT PROGRAM
**Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram –Experimental
System/Cooling Tower No. 2 (Bldg. 912)**

AGS-004-CWS-05



Legend

□ Solid Waste

△ Air Emissions

○ Wastewater

SS = Sanitary

Ⓟ Pump(s)

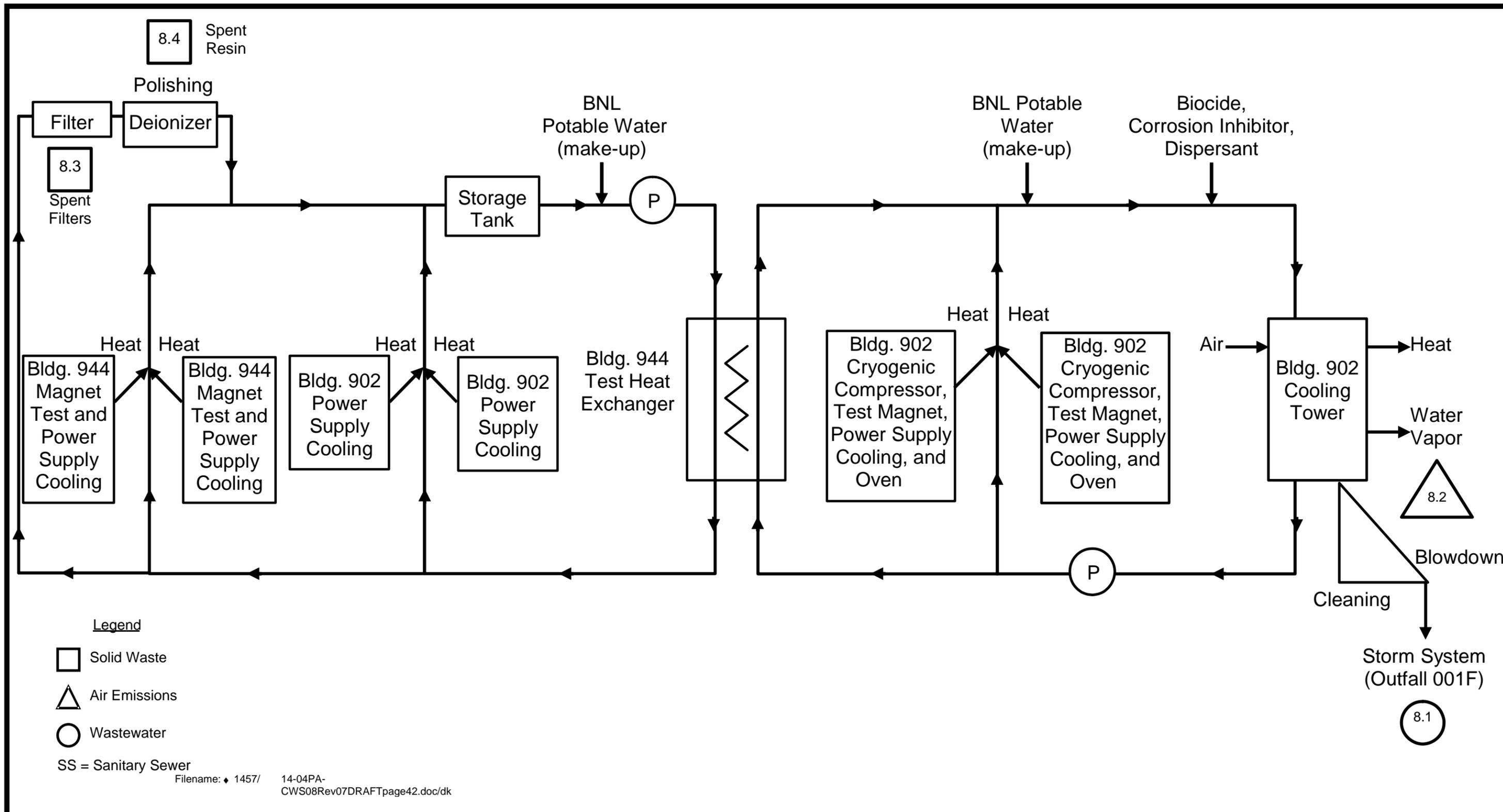
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**SYSTEM NOT OPERATIONAL –
Magnets & Power Supplies removed,
Cooling Tower dismantled**

..... Cooling water contains activation products in concentrations less than the drinking water standard.

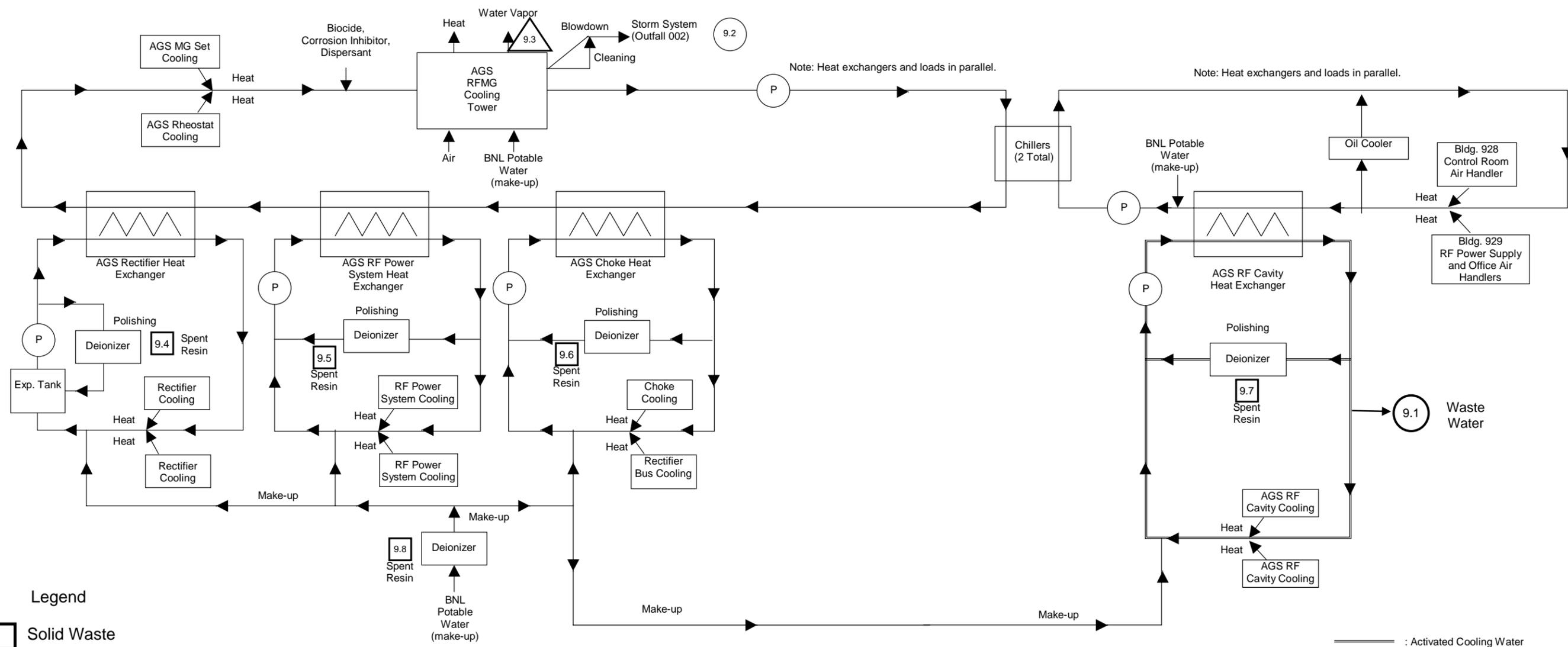
BROOKHAVEN NATIONAL LABORATORY
PROCESS ASSESSMENT PROGRAM
Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram – Experimental System and Cooling Tower No. 4
(Bldg. 912A)

AGS-004-CWS-07



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 PROCESS ASSESSMENT PROGRAM
Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram – Bldg. 944 Test System and
Bldg. 902 System/Cooling Tower

AGS-004-CWS-08



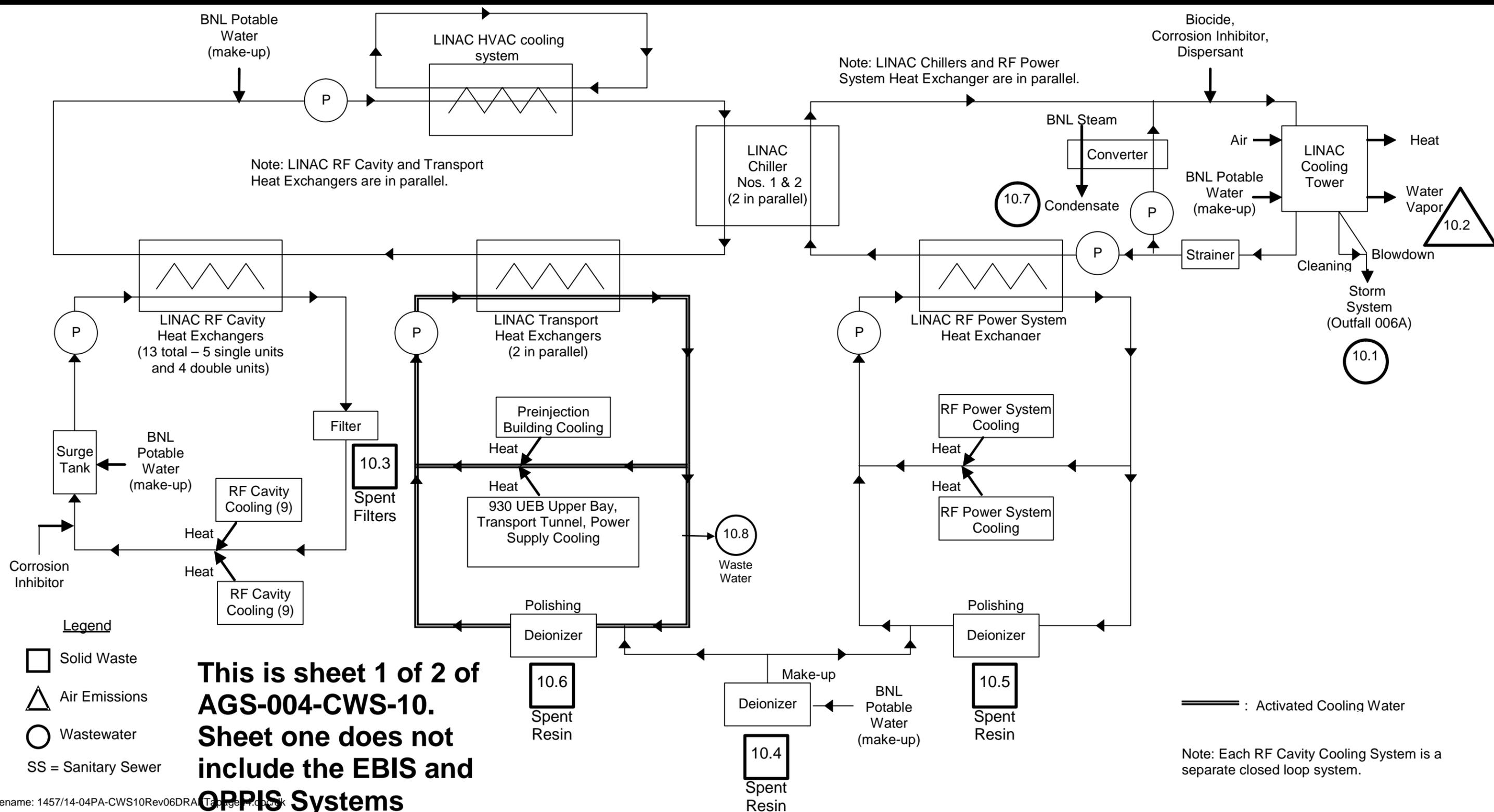
Legend

- Solid Waste
- Air Emissions
- Wastewater
- SS = Sanitary Sewer
- Pumps

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BROOKHAVEN NATIONAL LABORATORY
 PROCESS ASSESSMENT PROGRAM
Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram - AGS Rectifier System, RF Power System, Choke System,
RF Cavity System, Chilled Water System and RFMG Tower (Bldgs. 928/929)

AGS-004-CWS-09

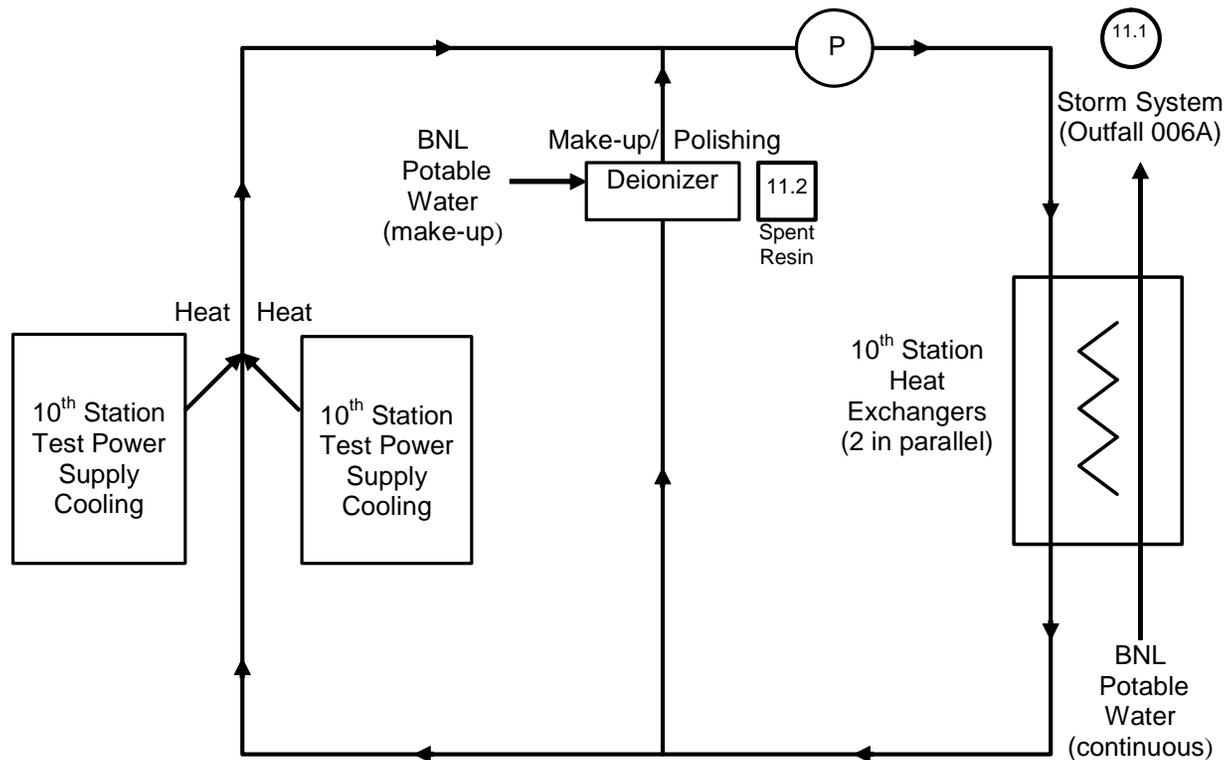


This is sheet 1 of 2 of AGS-004-CWS-10. Sheet one does not include the EBIS and OPPIS Systems

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BROOKHAVEN NATIONAL LABORATORY
 PROCESS ASSESSMENT PROGRAM
Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram - LINAC RF Cavity System, Transport Water System,
RF Power System and Chilled Water System/Cooling Tower (Bldg. 930)

AGS-004-CWS-10



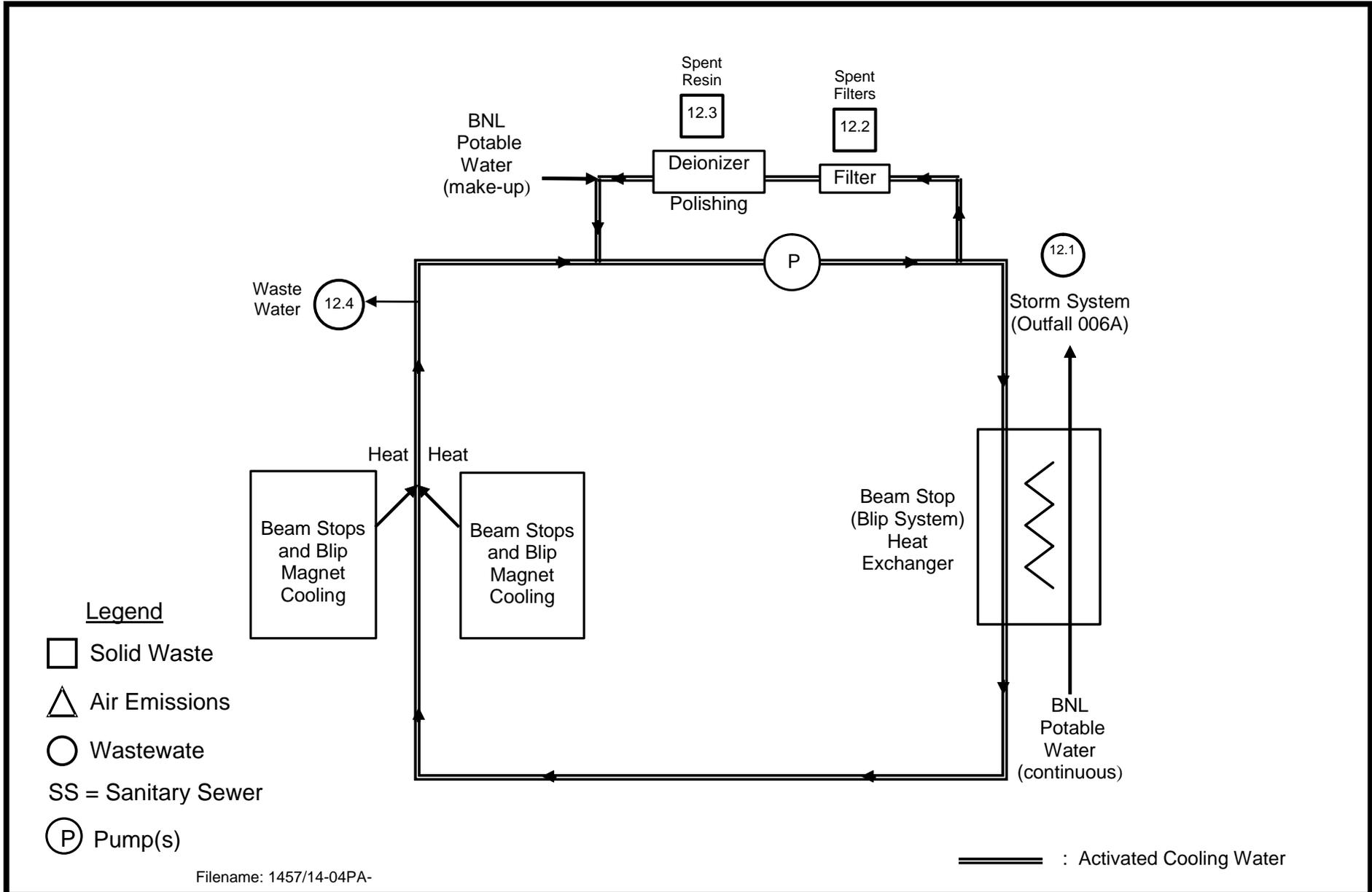
Legend

- Solid Waste
- △ Air Emissions
- Wastewater
- SS = Sanitary Sewer
- Ⓟ Pump(s)

Filename: 1457/14-04PA-

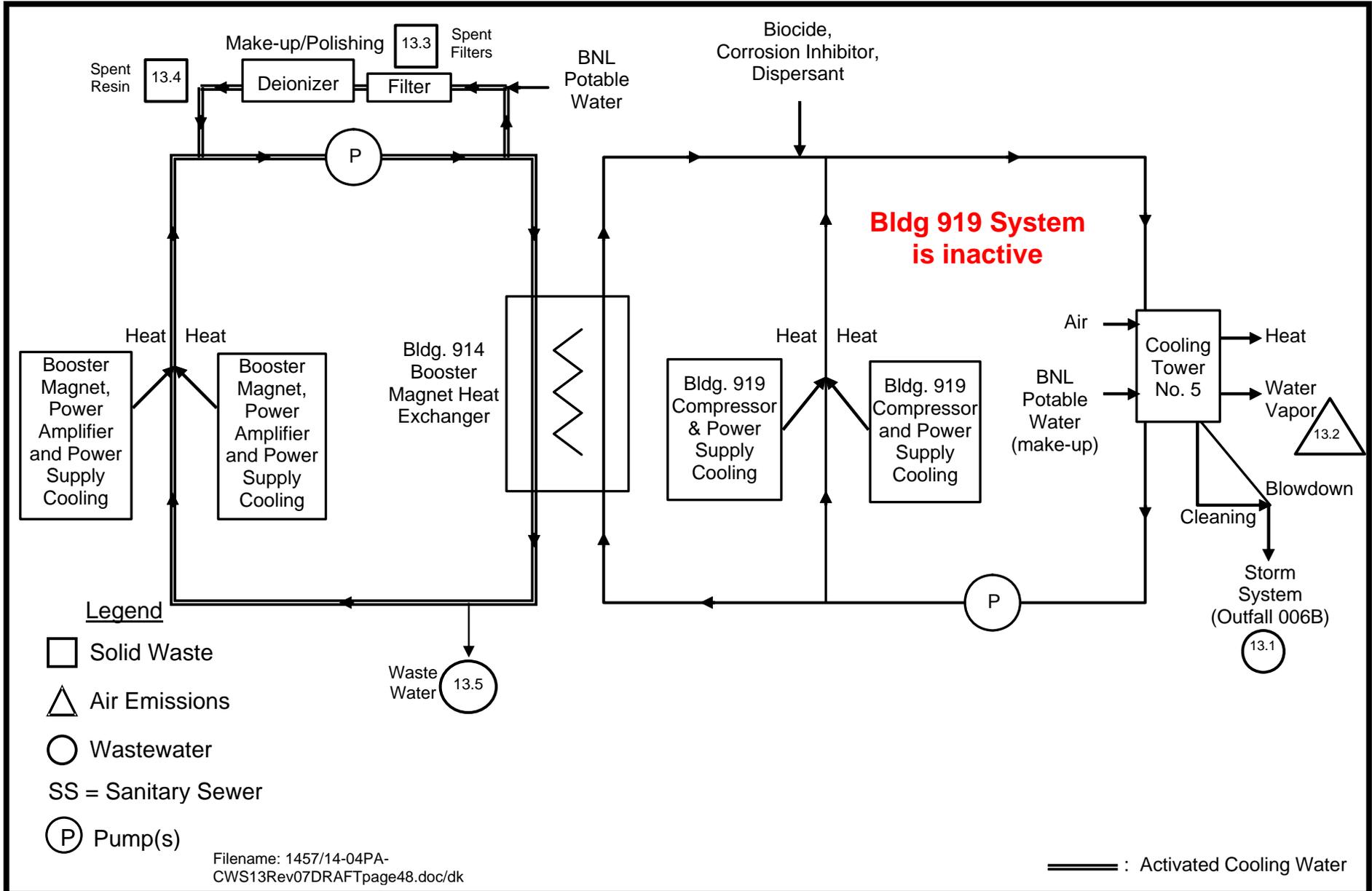
BROOKHAVEN NATIONAL LABORATORY
 PROCESS ASSESSMENT PROGRAM
Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram – LINAC 10th Station System (Bldg. 930)

AGS-004-CWS-11



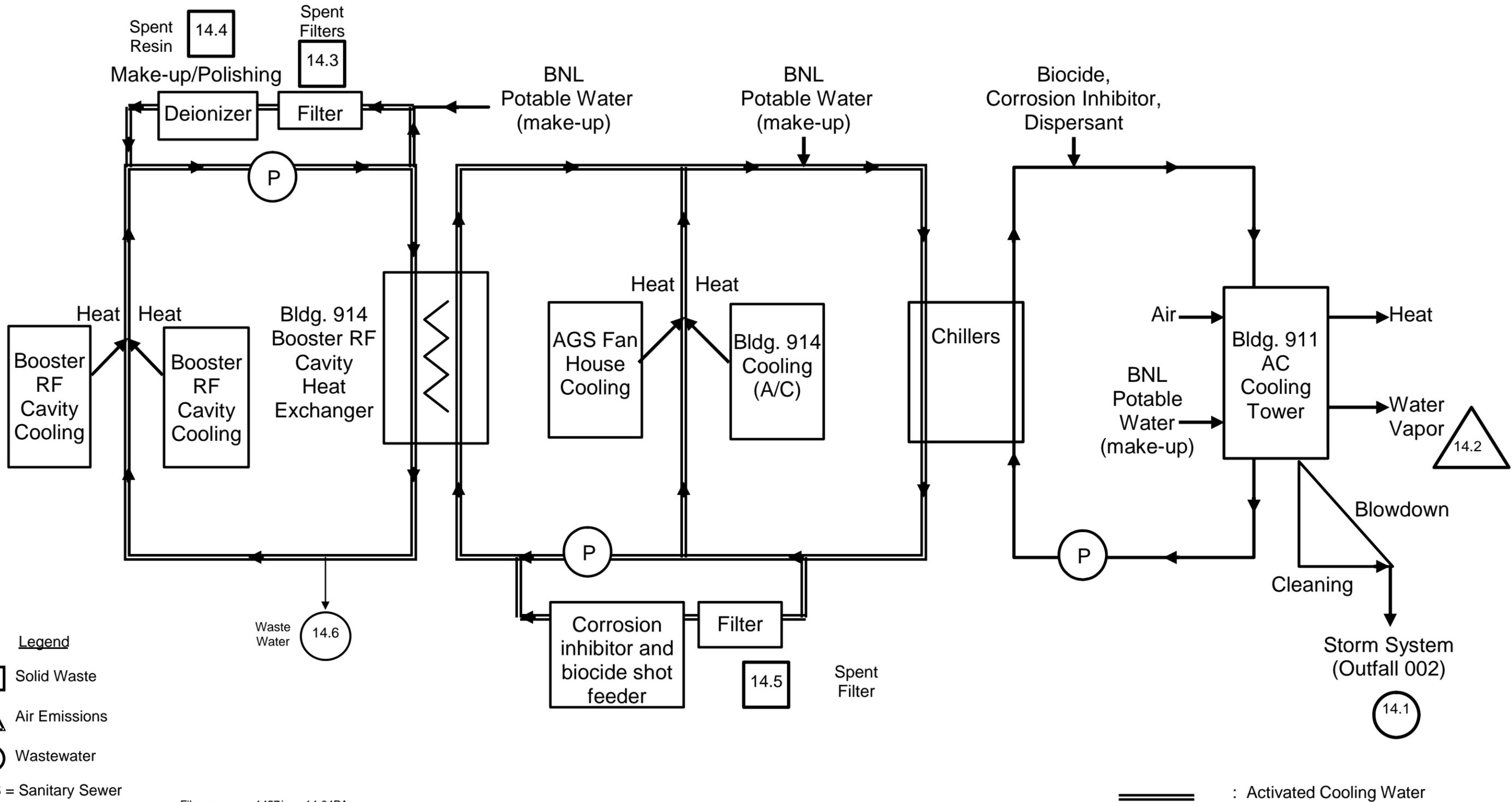
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 PROCESS ASSESSMENT PROGRAM
Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram – Beam Stops (Blip System) (Bldg. 914, 930, 946)

AGS-004-CWS-12



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 PROCESS ASSESSMENT PROGRAM
Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram – Booster Magnet System and
Cooling Tower No. 5 (Bldgs. 919/914)

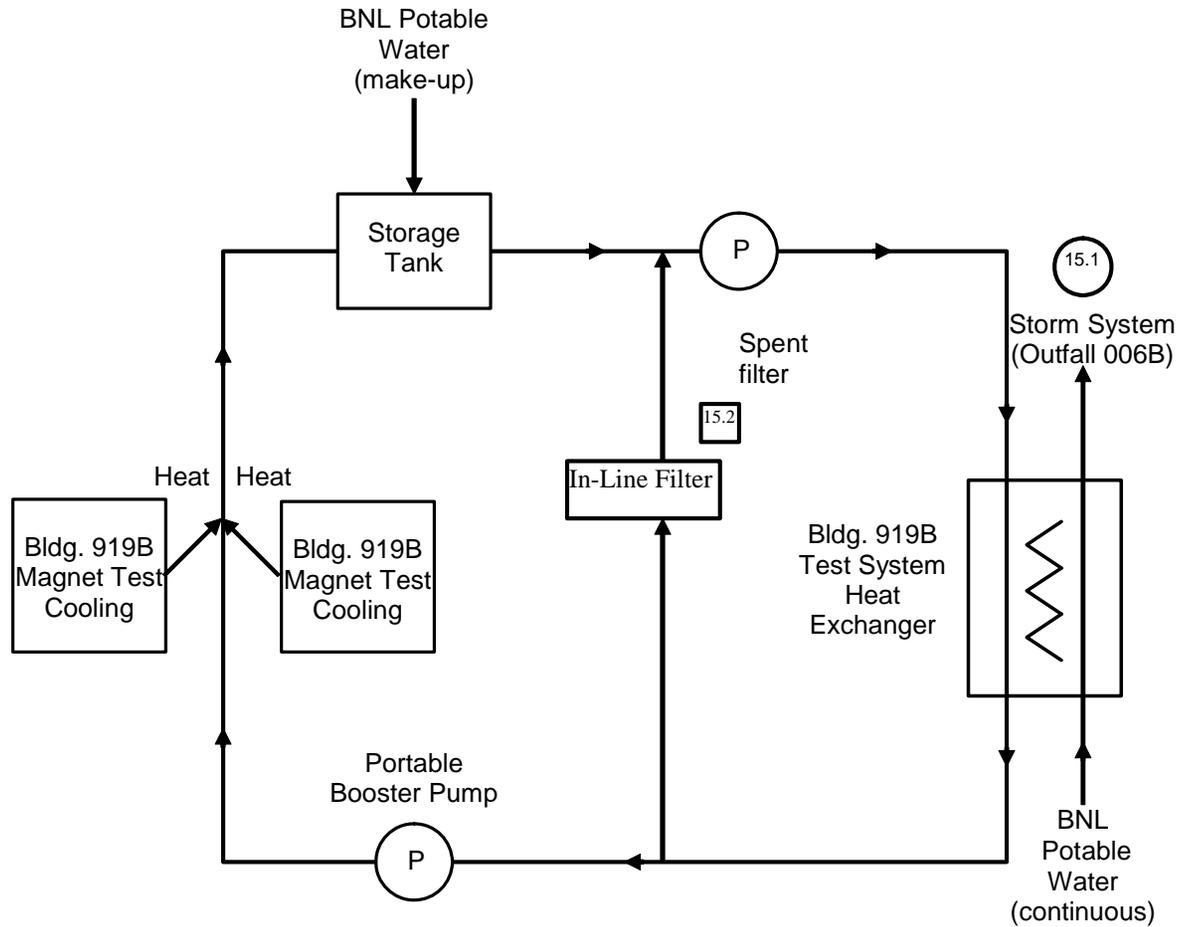
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 PROCESS ASSESSMENT PROGRAM
Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram – Booster RF Cavity System and Chilled Water
System, and A/C Cooling Tower (Bldgs. 914/911)

AGS-004-CWS-14



Legend

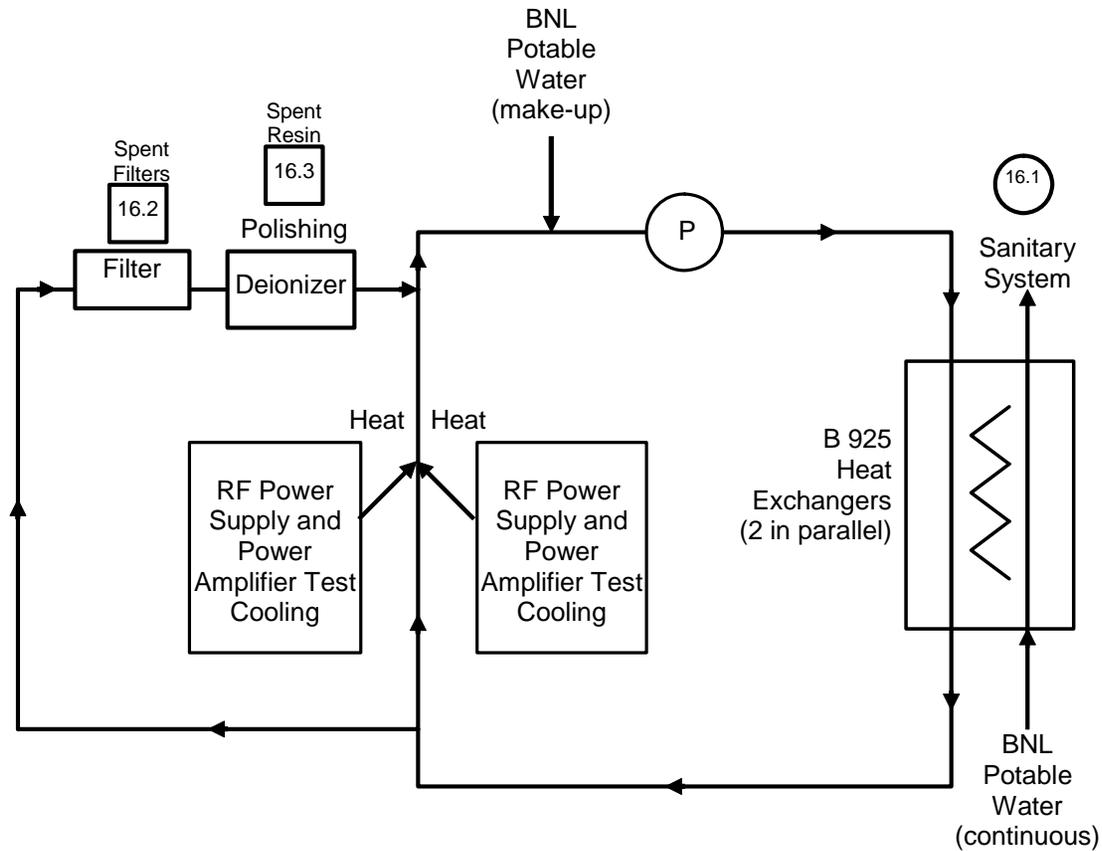
- Solid Waste
- △ Air Emissions
- Wastewater
- SS = Sanitary Sewer
- Ⓟ Pump(s)

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BROOKHAVEN NATIONAL LABORATORY
PROCESS ASSESSMENT PROGRAM

**Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram – Bldg. 919B Test System**

AGS-004-CWS-15



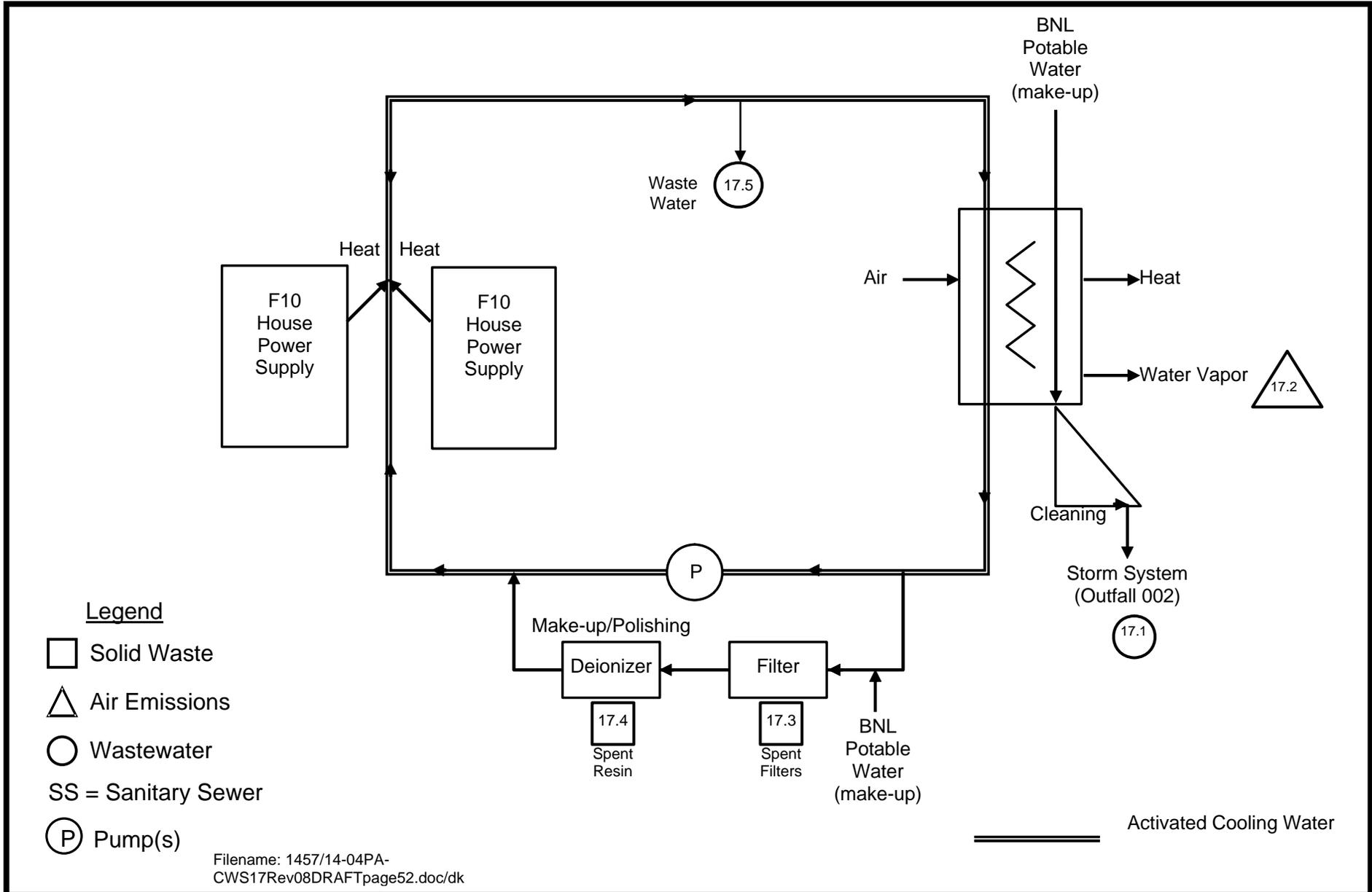
- Legend
- Solid Waste
 - △ Air Emissions
 - Wastewater
 - SS = Sanitary Sewer
 - Ⓟ Pump(s)

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BROOKHAVEN NATIONAL LABORATORY
PROCESS ASSESSMENT PROGRAM

**Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram – Bldg. 925 Test System**

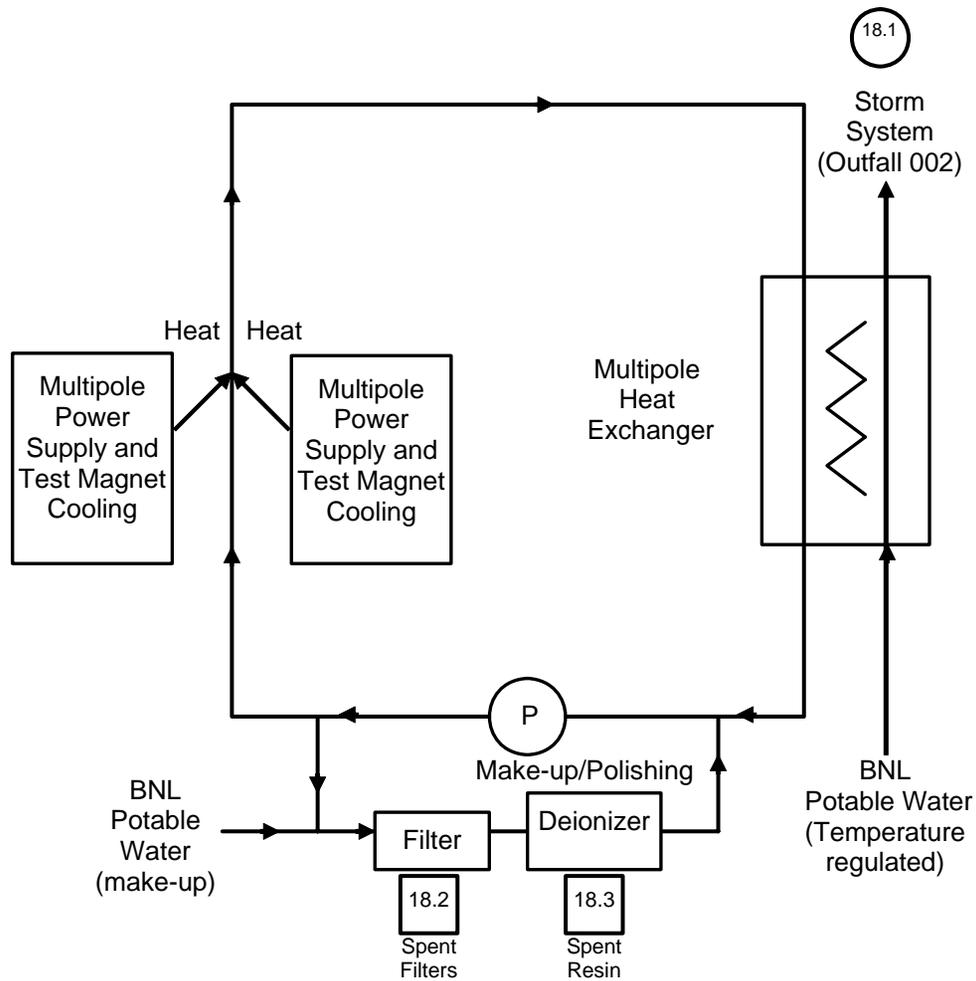
AGS-004-CWS-16



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PROCESS ASSESSMENT PROGRAM

**Alternating Gradient Synchrotron –Cooling Water Systems
Process Flow Diagram – F10 House Cooling System (Bldg. 932)**

AGS-004-CWS-17



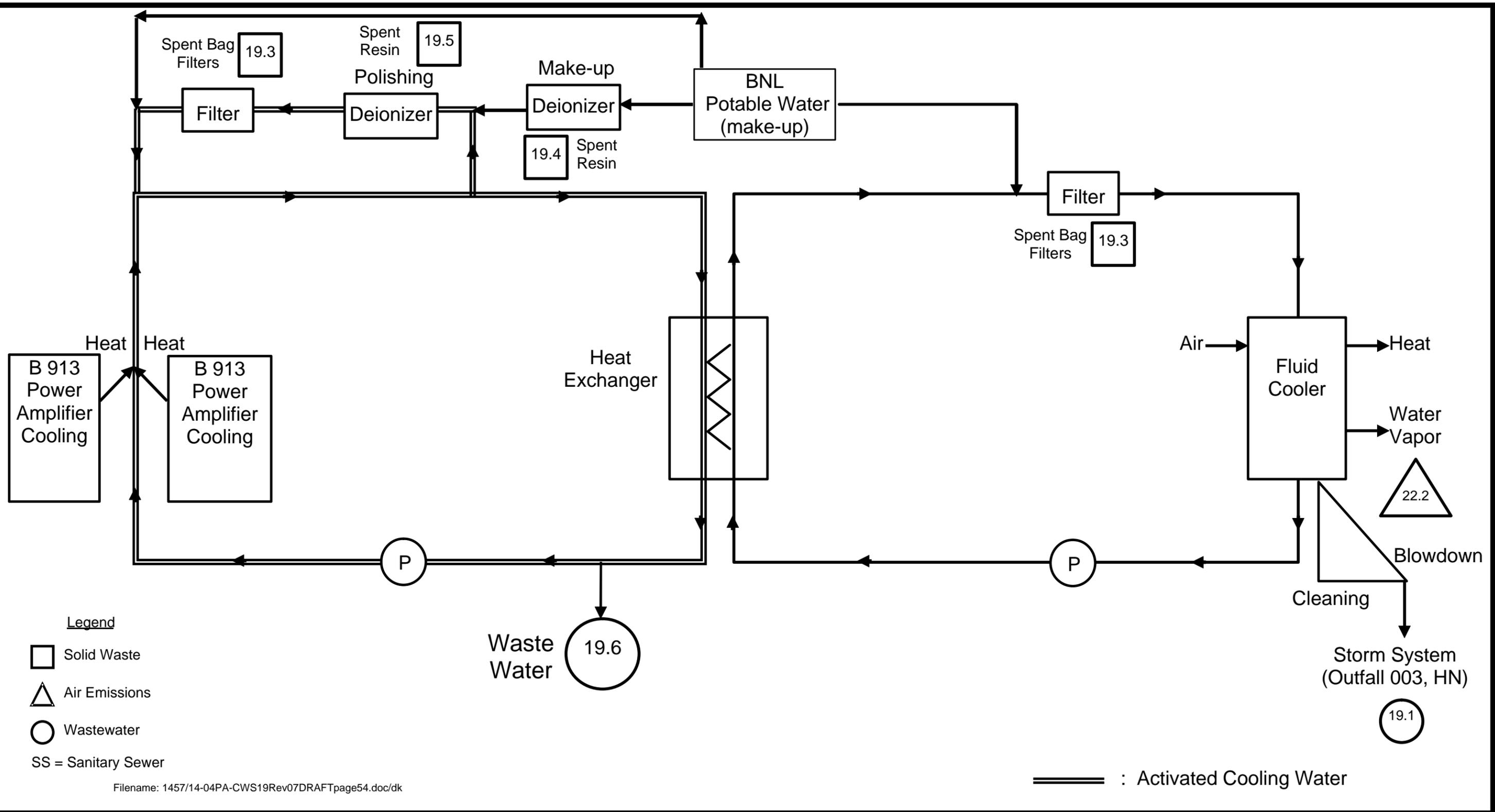
- Legend
- Solid Waste
 - △ Air Emissions
 - Wastewater
 - SS = Sanitary Sewer
 - Ⓟ Pump(s)

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BROOKHAVEN NATIONAL LABORATORY
PROCESS ASSESSMENT PROGRAM

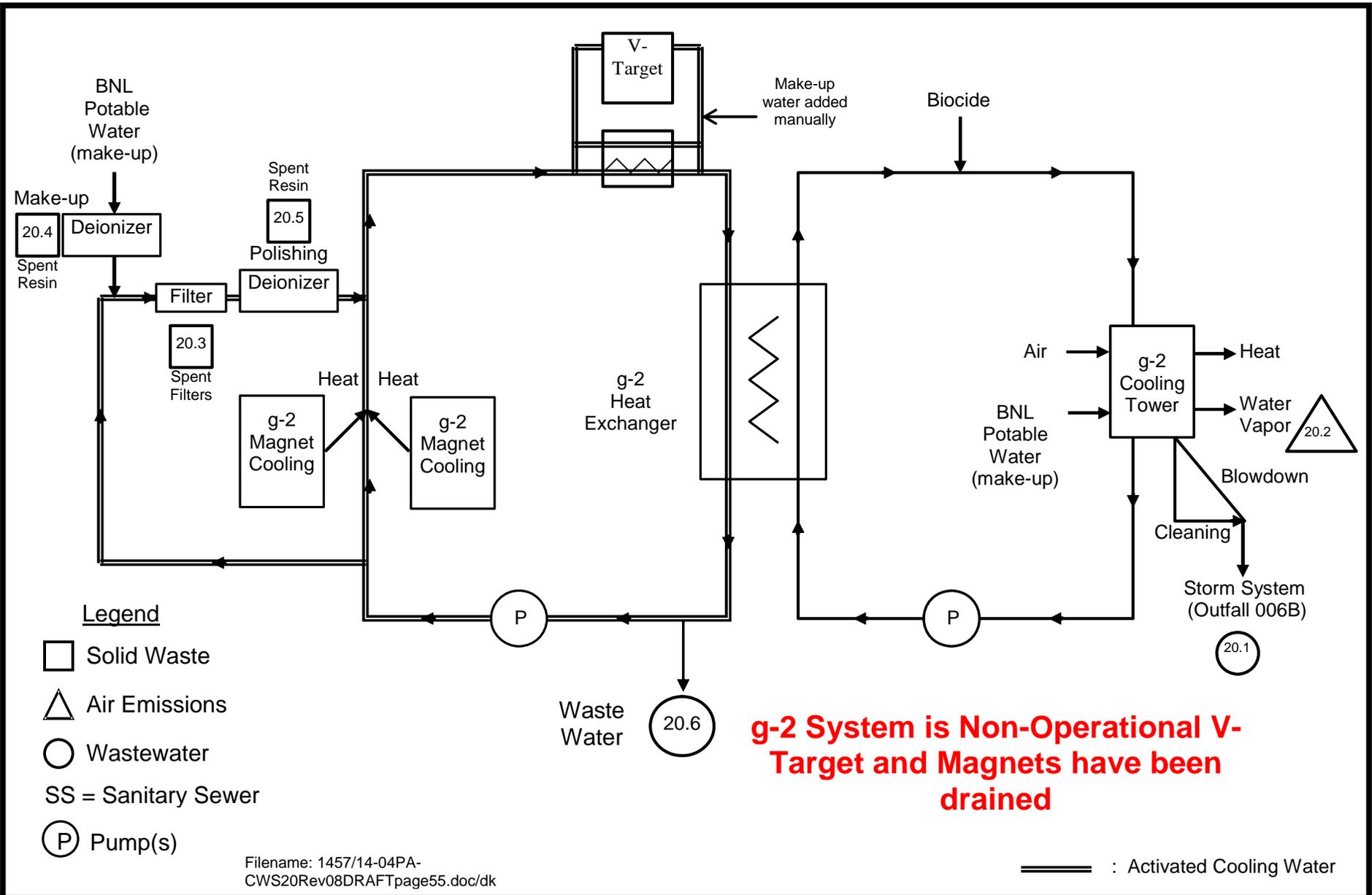
**Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram - Multipole Room Cooling (Bldg. 911)**

AGS-004-CWS-18



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 PROCESS ASSESSMENT PROGRAM
Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram – RF Power Amplifier (PA) Cooling Water System
(Bldg. 911/951)

AGS-004-CWS-19

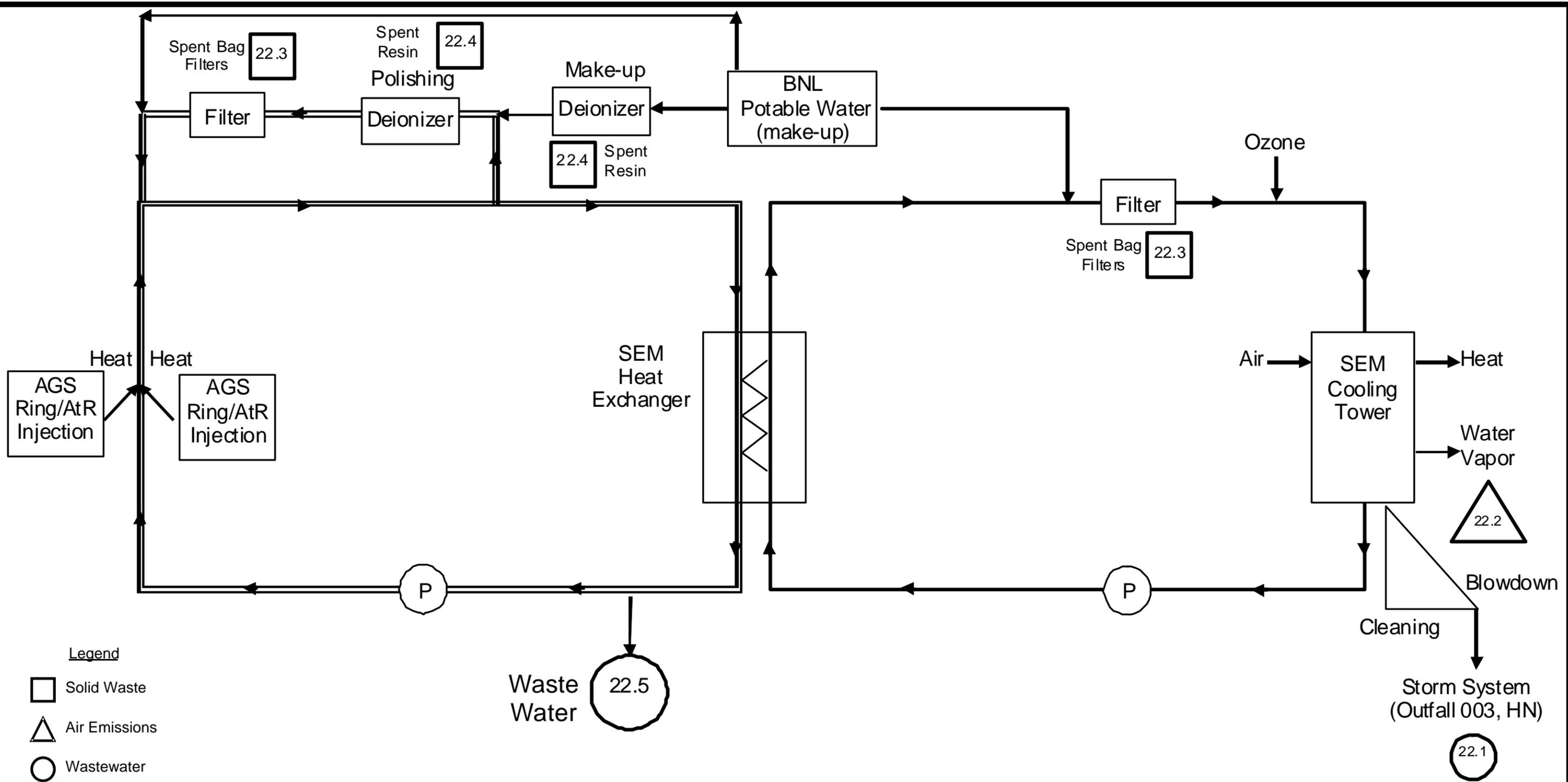


g-2 System is Non-Operational V-Target and Magnets have been drained

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PROCESS ASSESSMENT PROGRAM

**Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram - g-2 Cooling System and Tower (Bldg. 919)**

AGS-579-G2-1

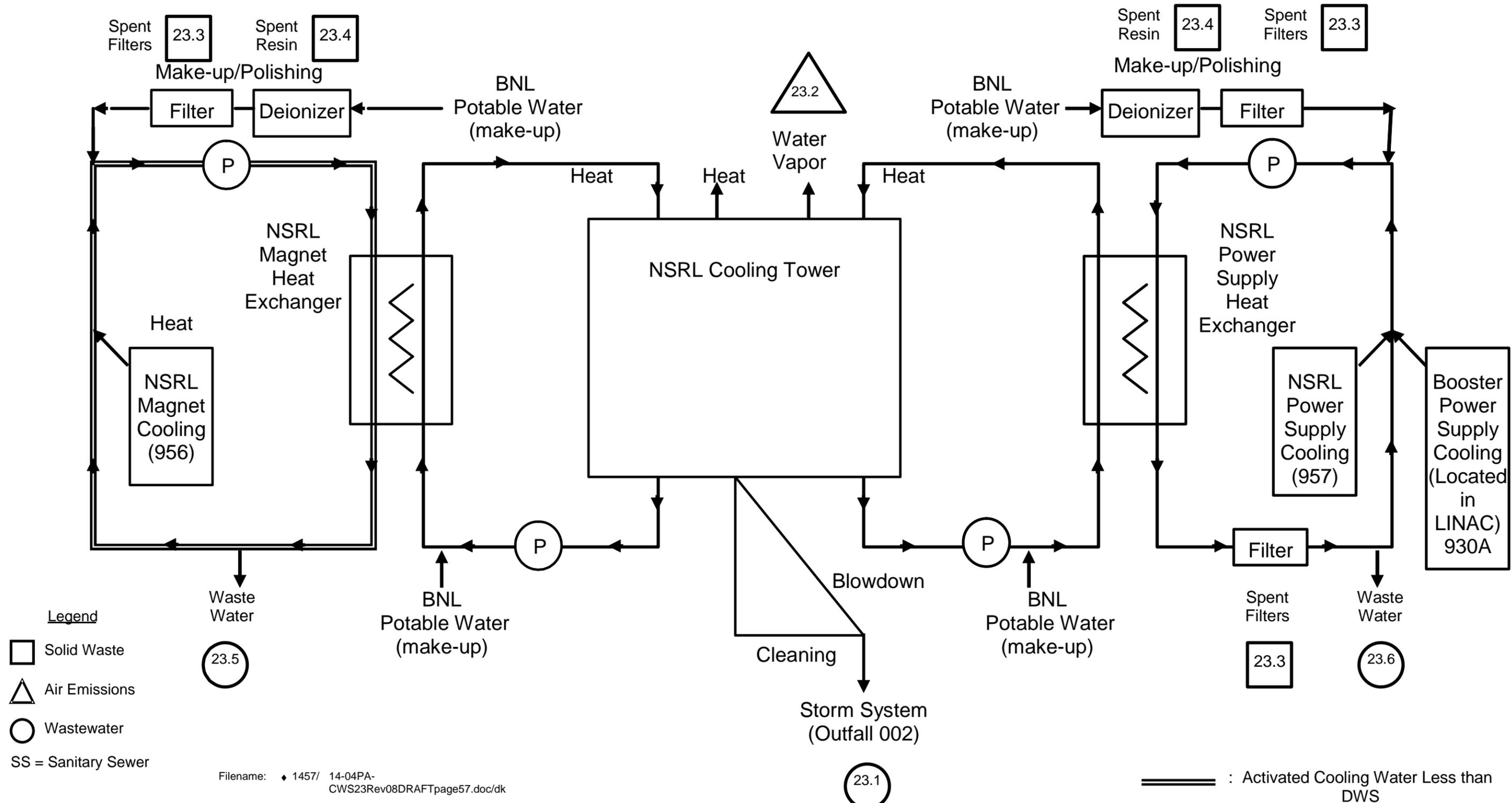


Legend
 □ Solid Waste
 △ Air Emissions
 ○ Wastewater
 SS = Sanitary Sewer

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 PROCESS ASSESSMENT PROGRAM
**Alternating Gradient Synchrotron – Cooling Water Systems
 Process Flow Diagram – SEM (AtR Injection) Cooling Water
 System/Cooling Tower (912A)**

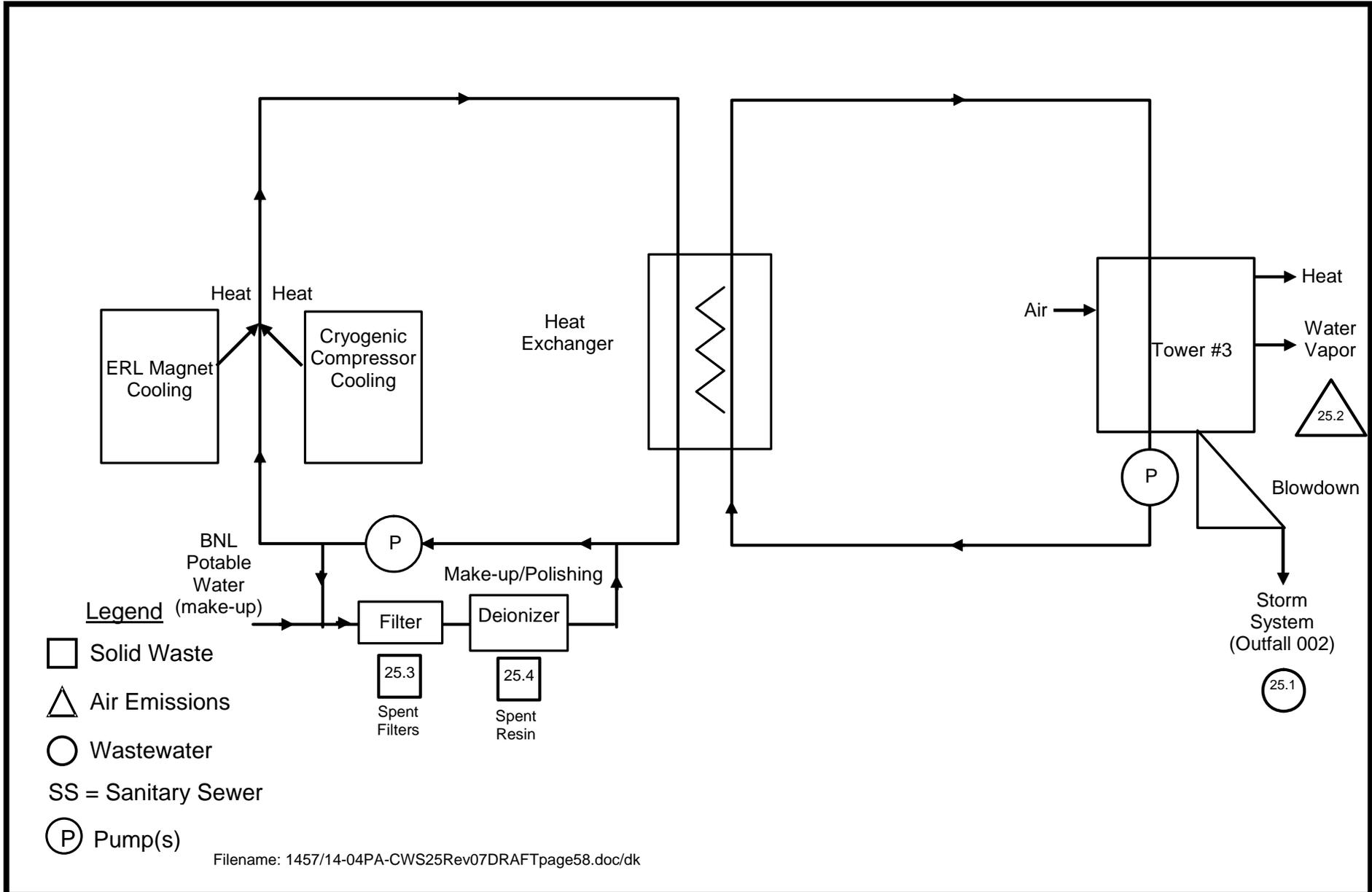
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PROCESS ASSESSMENT PROGRAM

**Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram – NSRL Cooling System and Tower (Bldg. 957)**

**CAD-595-BAF-04
AGS-004-CWS-23**



BROOKHAVEN NATIONAL LABORATORY
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Alternating Gradient Synchrotron – Cooling Water Systems
Process Flow Diagram – Energy Recovery LINAC (ERL) Cooling (Bldg. 912)

AGS-004-CWS-25