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ENVIRONMENTAL ENGINEERING SURVEY CNC CHARLESTON SC
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NAVFAC SOUTHERN

ENVIRONMENTAL ENGINEERING SURVEY

NAVAL BASE
CHARLESTON, SOUTH CAROLINA

JANUARY 1976

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA

Enclosure (1)

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SUMMARY & RECOMMENDATIONS

1. DOMESTIC WATER TREATMENT

As noted in reference (b), the distribution and storage capacity of the existing Naval Base water system is not adequate to provide the peak domestic demands south of Viaduct Road without excessive loss of pressure in the water main. Reference (b) recommended to alleviate the problem that a 16" water main be constructed from the City of Charleston 24" water main on Meeting Street to the base distribution system near Viaduct Road and Hobson Avenue as noted in J. E. Sirrine Company Engineering Study of 1 March 1962. It was also recommended by reference (b) that the J. E. Sirrine Company Study be updated to determine the most economical means of meeting the water requirement of the South Naval Base. Efforts since then to have the City increase its pressure to the Naval Base have been unsuccessful.

2. BOILER WATER TREATMENT

The five boilers of the Power Plant Building 32, have received solvent cleaning for the removal of scale within the past year and the Public Works Department has employed a full time boiler water treatment employee. Accordingly, the waterside of the boiler is in good condition. It is recommended that boiler water samples continue to be routinely submitted to BUMINES for simultaneous analysis in accordance with SOUTHNAVFACINST 11330.3F of 30 January 1974. Appendix B is submitted for your information and assistance.

3. SWIMMING POOL WATER TREATMENT

Three of the four swimming pools have their backwash water connected to the domestic wastewater collection system. Plans are underway to connect the backwash from the Officer's Pool to the domestic wastewater collection system. All pools were closed for the winter season; however, in discussion with Mr. Ernie Croucher and review of the pools, it was noted that the pools have adequate water treatment. The pools are adequate with respect to pollution abatement with the exception of the Officer's Pool which requires the backwash water to be discharged into the domestic wastewater collection system. Discharge, in the Spring, of the water from the pools into the storm drains does not cause a pollution problem.

4. COOLING WATER TREATMENT

The contractor, who is well qualified, treats the water for the cooling towers. Thorough inspection of the contractor's work is necessary for satisfactory cooling tower water treatment results. The contract specifications and control procedures should be modified to conform with Appendix D.

5. DOMESTIC WASTEWATER COLLECTION & TREATMENT

Due to the complexity of the domestic wastewater collection system of the Naval Base and engineering contract was recently completed to update the As-Built Drawings of the underground domestic sewer system and storm sewer system. Four cross connection were found during the updating of the As-Built Drwaings and two projects to correct this condition have been submitted.

In connection with swimming pools, NAVMED P-5010-3, Chapter 3, state in part that in backwashing filters, discharging wastewaters to sewers, and adding makeup water, precautions must be taken to prevent cross flow which might contaminate the pool or the drinking water supply. Dangerous cross connections must be prevented by the use of devices such as surge tanks and air gaps. Water from swimming pools is dumped once each spring into storm drains, thereby eliminating contamination hazards.

Since the City of North Charleston is modifying their wastewater treatment plant to provide secondary treatment and the cost for domestic wastewater treatment will increase, it is recommended that the domestic wastewater flow be carefully monitored to determine the extent of infiltration.

6. FIREFIGHTING SCHOOL TRAINING AREA

The Oil/Water Separator in the present condition allows excessive infiltration of rain water runoff to enter the sanitary sewer and it is reported that spring tides back into the sanitary sewer line. This condition should be corrected at an early date.

7. SOLID WASTE DISPOSAL

The solid waste collection and disposal from the Naval Base Housing, Golf Shop, Commissioned Officer Club, Warehouse and Navy Exchange by competitive contract is economical and environmentally satisfactory and should be continued.

Other solid waste is collected and hauled by the station forces to the Charleston County facility for disposal under Contract N62467-74-C-1804. The contract cost for disposal by the County is $2.37/Ton. It is recommended that this contract be continued until engineering studies underway in connection with energy recovery have been completed.

Engineering Service Request No. 5279-169, prepared in December 1975, in connection with Waste Cardboard Recycling Program of the Naval Station submits information which should be helpful in the establishment of a recycling program for cardboard.

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I. INTRODUCTION

In accordance with Naval Facilities Engineering Command Instruction 5450.19B of 15 November 1974, an Environmental Engineering Survey was conducted of the Naval Base, Charleston, South Carolina during November and December 1975. The Naval Base activities included in the survey are the Naval Shipyard, Naval Station, Naval Supply Center, Fleet Ballistic Missile Submarine Training Center, Fleet and Mine Warefare Training Center, Navy Regional Medical Center and Marine Barracks. The water distribution system, sewage collection system and solid waste collection are common to the above activities and the activities are served by one Public Works Department; therefore, the environmental engineering survey was conducted for the Naval Base in lieu of separate activities. The survey was coordinated with the Public Works Officer with assistance of the Navy Environmental Support Office(NESO).

II. PERSONNEL CONTACTED

CAPT Joseph Lapolla	Public Works Officer
LCDR R. G. Baker	Fleet Training Center
Chief D. W. Sincebaugh	Environmental Health, NAVREGMEDCEN
Dr. Iverson	NESO, Port Hueneme, CA
Mr. R. F. Duncan	Head, Design Division, Public Works
Mr. J. W. Sneed	Environmental Engineer, Public Works
Mr. F. T. White	Utilities Superintendent, Public Works
Mr. Weldon Jones, Asst.	Utilities Superintendent, Public Works
Mr. Funderburk	Boiler Foreman, Public Works
Mr. Earl Acre	Boiler Foreman, Public Works
Mr. Morrow	City of North Charleston Sewer District
Mr. Braswell	Port Hueneme, CA
Mr. Owen	Port Hueneme, CA

III. WATER TREATMENT

A. GENERAL

Potable water purchased from the City of Charleston enters the Naval Base through four meters; however, two of the lines entering the Naval Base are normally closed and used only during emergencies. The principal sources of supply on the Naval Base are a 16" main located near Commandant, Sixth Naval District Headquarters in the old hospital area and a 10" main entering at the third street gate. There are two additional water mains--a 12 inch line north of Noisette Creek and a 8 inch line located at the third street gate. Water is stored on the Naval Base in two elevated tanks, a 500,000 gallon capacity tank in the COMSIX area and a 250,000 gallon capacity tank in the South Naval Station area. The two elevated tanks are supplemented by two ground storage tanks, a 1,500,000 gallon tank located at Avenue D and Commissary Store, and a 500,000 gallon steel tank located in the South Naval Station area. To keep the water from becoming stagnant, it is pumped each week from the ground tanks into the distribution system. For the same reason, the water quality in the 500,000 elevated tank is maintained weekly temporarily, closing a valve in the 16 inch main from the City to allow the tank water to feed into the distribution system; then opering the 16 inch valve and refilling the tank with fresh City water. The 250,000 gallon elevated tank in the South Naval Station area usually stays empty unless water is pumped into it since the tank elevation is above the pressure gradient of the distribution system.

Reference (b) noted that the transmission and storage capacity of the existing Naval Base water system is not adequate to provide the required flow from the principal source of supply to the area south of Viaduct Road, approximately 2½ miles away, without excessive loss of pressure. It was also noted that the low water pressure requires Public Works to bypass the water softener in Building 123, Fleet Power Plant, and on other occasions in the power plant could not be operated because the water pressure was too low to feed water to the boilers. It is reported that low water pressure during the summer months restricted water service to the fleet. Additionally, reference (b) noted that the low water pressure problem is aggravated by the operation of the Fleet Training Center Fire Fighter School booster pumps. The booster pumps take suction from the 12 inch fresh water main. This causes the water to flucatuate rapidly between 10 psig and 80 psig.

Additionally, it was noted in reference (b) that by contract NBY37325, the J. E. Sirrine Company, Engineers - Architects, in a Utilities Systems Study for the Naval Base had made certain recommendations for the improvement to the potable water distribution system. One recommendation which has not been implemented and should be considered at this time is to install a new 16 inch water main from the City main to the Naval Base distribution system. This main will be approximately 3700 feet long, connected to a 24 inch city main in Meeting Street and to the base distribution system near the intersection of Viaduct Road and Hobson Avenue.

B. POTABLE WATER TREATMENT

Water purchased from the City of Charleston requires only chlorination when and if the free chlorine content is less than 0.2 mg/l. Water treatment by the City of Charleston consists of pre and post chlorination, coagulation and filtration.

Potable water is purchased on a "sliding scale" rate and averages approximately 10¢ per 1000 gallons. At today's inflationary costs, water for the Naval Base is acquiried at a reasonable cost.

C. INDUSTRIAL WATER TREATMENT

External and internal boiler feedwater treatment and cooling water treatment is the limit of industrial water treatment for the Naval Base.

(1) Boiler Water Treatment

One hundred and three (103) boilers serve the Naval Base. The boilers are fired with four types of fuel consisting of coal-automatic stoker fired (5 boilers), oil-gun type burners and gas-gun type burners. The four fuels used are coal, Navy Special Oil, No. 2 fuel oil and natural gas. Since the low pressure hot water boilers do not require water treatment, they are not discussed in this report.

a. Building No. 28, BOQ No. 6, has a boiler with an input of 3,450,000 BTUs/hr, operates at a gauge pressure of 26 to 32 pounds per square inch, has a chemical feeder and a sample cooler, is fired on Navy Special Oil. The boilers were manufactured by PAWNEE. Chemicals used for boiler water treatment are trisodium phosphate, caustic soda and tannin.

b. Building No. 28, BOQ No. 5 has a boiler with an input capacity of 3,864,000 BTUs/hr, operates at pressures between 30 and 40 pounds per square inch, has a sample boiler water cooler and chemical pumps. Chemicals used for boiler water treatment are tannin, trisodium phosphate and caustic soda. The boiler is fired on Navy Special Oil. At the time of the visit the boiler was undergoing an annual overhaul consisting of opening up the firesides for cleaning and inspection, making minor repairs, checking of all controls and pressure relief valves and shop testing the blowdown valve.

c. Building No. 44 of the South Naval Base has two boilers which have an input capacity of 20,000,000 BTUs/hr each, are water tube boilers provided with deaeration heaters, have boiler water sample coolers and chemical feeders. Boiler water treatment is provided by sodium sulphite and caustic soda. At the time of the visit, the Red Shriver Boiler Repair Company of Charleston was replacing all boiler tubes in Boiler No. 2. The tube failure was the result of fireside deteriation. Navy Special Oil is used to fire the boilers.

d. Building No. 69 which provides heat for the Naval Station BEQs operates at a pressure of 11 to 20 psig, is fired on Navy Special Fuel Oil, has an input capacity of 6,787,000 BTUs/hr and has sample boiler water coolers and chemical feeders. Chemicals used for boiler water treatment are trisodium phosphate, tannin and caustic soda.

e. Building No. 61, Fleet Ballistic Missile Submarine Training Center, has two boilers with an input capacity of 10,047,500 BTUs/hr for each boiler, operates at a pressure of 185 psig, chemicals for water treatment are fed through the condensate tank and sample boiler water coolers are installed. Boiler water treatment is provided by use of trisodium phosphate, caustic soda and tannin.

f. Building No. 2 has two boilers which operate at 125 psig, are provided with sample boiler water coolers and chemical feeders. The boilers are fired on Navy Special Oil and chemicals which provide boiler water treatment are trisodium phosphate, caustic soda and tannin. Boiler No. 1 was retubed in March 1975 and Boiler No. 2 in December 1974. Boiler No. 1 has an input capacity of 17,000,000 BTUs/hr while Boiler No. 2 has an input capacity of 12,000,000 BTUs/hr. This plant is seventeen (17) years old.

g. Building No. 648, Naval Station Correction Center has a boiler with an input capacity of 1,725,000 BTUs/hr, operates at a pressure of 12 to 18 psig, is fired on No. 2 fuel oil and is "shot fed" boiler water treatment. Chemicals for boiler water treatment are trisodium phosphate, caustic soda and tannin.

h. Building No. 640, the Chief Petty Officer's Club, has a boiler that operates at a gauge pressure of 6 to 10 pound per square inch, has an input capacity of 1,380,000 BTUs/hr, is oil fired on No. 2 fuel, has a sample boiler water cooler and a chemical feeder. Chemicals used for water treatment are trisodium phosphate, tannin and caustic soda.

i. Building No. 71, Navy Exchange Cafeteria, has two boilers with an input capacity of 5,022,000 BTUs/hr for each boiler, operates at a gauge pressure of 50 to 52 pounds per square inch, is fired on Navy Special Oil and has a sample boiler water cooler and chemical feeder. Boiler water treatment is provided by caustic soda, tannin and trisodium phosphate.

j. Building No. 123, Active Fleet Power Plant, contains four boilers which operate at a gauge of 150 pounds per square inch, are provided with a water softener, deaeration heater, chemical feeders and sample coolers. Navy Special Oil is used as fuel for all boilers. Boilers No. 1 and No. 2 have input capacities of 19,200,000 BTUs/hr each. A minimum water pressure in the adjacent water main of 30 pounds per square inch is required to operate this Boiler Plant, which provides steam to the Active Fleet.

k. The new hospital of the Naval Regional Medical Center has three boilers with input capacities of 20,922,000 BTUs/hr each. All boilers operate at a pressure of 90 to 100 pounds per square inch gauge, and are fired on natural gas with No. 2 fuel oil backups. The boilers are provided with chemical feeders and sample coolers. Chemicals used for boiler treatment are trisodium phosphate, caustic soda and tannin. All hospital boilers are of Cleaver Brooks Manufacturer.

l. Building No. 72 has boilers which have been idle since 1972. Consideration is being given to overhauling the boilers and placing them into operation. These boilers are fired on natural gas and Navy Special Oil, operated at a pressure of 125 pounds per square inch and when placed into operation will receive the same water treatment as other boilers.

m. Building NH 62 has two boilers with an input capacity of 1,171,000 BTUs/hr each. The boilers are low pressure boilers which operate at a pressure of 6 to 10 pounds per square inch and are fired on No. 2 fuel oil. Operation of the boilers are required year around and chemical treatment of the boiler water is not required since the boiler operates at low pressure.

n. Building No. 1137, the Naval Station Nursery, has an input capacity of 1,338,880 BTUs/hr, operates at a gauge pressure of 6 to 10 pounds per square inch and is fired on No. 2 fuel oil. This boiler, as the boiler in Building No. 68, is used only for heating in the winter season. Since the boiler operates at a low pressure the boiler water requires no treatment.

At the time of the visit the boiler was receiving the annual overhaul.

o. The boiler in Building No. 68, has an input capacity of 2,008,320 BTUs/hr, is oil fired on No. 2 fuel oil, operates at 8 to 10 pounds per square inch pressure. Since this is a low pressure boiler, chemical treatment of the boiler water is not required.

p. Building No. 86, the Officer's Club, has a boiler with an input capacity of 3,144,800 BTUs/hr, and the boiler operates at a pressure of 10 to 13 pounds per square inch. The boiler is fired on No. 2 fuel oil.

q. Building No. 32, the Shipyard Power Plant, has five boilers, each capable of providing 60,000 pounds of steam per hour while operating at a pressure of 415 pounds per square inch. The boilers are equipped with chemical pump feeders, boiler water sample coolers and are coal automatic stoker fired. Chemicals used for boiler water treatment are trisodium phosphate, caustic soda and sodium sulphite.

The water sides of Boilers 11 and 12 have recently been solvent cleaned by contract and, more recently, boilers 9, 10, and 13 have been solvent cleaned by contract. The contractor disposed of chemical clean out wastes NaHF (NaF) by hauling these wastes from the site by tank truck. The power plant normally consumes 150 tons of coal per day and disposes of 12 to 15 tons of ash. Ash is disposed on base where needed such as fill for low areas on unpaved roads.

(2) Cooling Water Treatment

The cooling water of the cooling towers for the air conditioners is treated by contract N62467-74-C-0357. The Naval Base is serviced by approximately sixty (60) cooling towers with twenty-one (21) cooling towers in use the year around. The cooling towers examined were found to be free of scale and corrosion. Calgon products are used in the treatment of the cooling tower water by the contractor. Accordingly, the cooling tower treatment is effective and free of pollution. The contractor of contract N62467-74-C-0357 is TECHNICAL SPECIALITIES CORPORATION of Decatur, Georgia. The air conditioning units range in size from 5 tons to 1000 tons. Appendix "A" is a copy of the type pollution Control Monitoring Report furnished each month by the contractor. Appendix D is furnished as a guide for cooling tower water treatment.

(3) Swimming Pool Water Treatment

The four swimming pools of the Naval Station are under the cognizance of the Special Services Officer. At the time of the survey all pools were closed for the winter season. In conversation with the Special Services Officer, it was learned that the chlorine residuals are maintained between 0.5 and 0.75 ppm and the pH is maintained between 7.2 and 7.6 which is within prescribed limits.

IV. WATER POLLUTION CONTROL

A. General

Several water pollution deficiencies were found and investigated. These deficiencies are analyzed and discussed in the following paragraphs.

B. Domestic Wastewater System

In reference (b), it was noted that an engineering contract was in progress to provide As-Built Drawings of underground utility systems and locate cross connections between sanitary and storm sewers. Several cross connections were found by the engineering contractor and projects are being prepared for the separation of these sewer lines.

The wastewater is treated by the City of North Charleston under contract N62467-68-C-0334. Cost of wastewater treatment is on a sliding scale rate depending upon the quantities of wastewater involved. The cost for this service to the Naval Base is approximately 20¢ per 1000 gallons of wastewater.

The City of North Charleston is adding secondary treatment to their wastewater treatment plant which is being designed by Metcalf and Eddy, Inc. The Navy's share of the cost for the secondary treatment addition will be based upon the volume of wastewater from the Naval Base as compared with theoverall volume of wastewater treated by the City of North Charleston. A project MCON P-022, FY77 has been submitted to finance the Navy's share of this project. Since flow is the basis of the contract service, it becomes important that the volume of Naval Base Wastewater be accurately determined.

Page 3, paragraph 2. Technical Provision of Contract N62467-68-C-0334 provides that all service furnished by the Contractor (City of North Charleston) shall be measured by suitable metering equipment of standard manufacture, to be furnished, installed, maintained, calibrated and read by the contractor at his expense. A $10,000 connection charge payment was made by the Navy for the government's portion of the metering expense. At the present date there is no meter on the Naval Base Wastewater line prior to its flow into the North Charleston Sewer District (NCSD) lift station. Two wastewater lines enter the lift station, one from the NCSD (a metered pressure line) and one from the Naval Base (a gravity flow line which is not metered). The lift station is provided with a venturi meter on the discharge side of the pumps. The venturi meter does not operate since solids in the wastewater continuously stop-up it. Accordingly, the volume of wastewater from the lift station is estimated using the time clock recording on the three pumps which operate at three different speeds and operate independently as well as together. Under these conditions, it is not likely that 2 percent accuracy in determining the Naval Base flow can be maintained as required by the service contract.

In conversation with Mr. Morrow of NCSD on 19 Nov 1975, it was noted that the Naval Base wastewater flow doubles during periods of heavy rain and that the flow increases at the time of high tide. If this condition continues after the known cross connections have been corrected, additional action for the elimination of infiltration is required. Normally the three prime sources of excess water are infiltration into individual building services, infiltration into gravity sewer lines and water overflowing manhole covers. The first source is impractical to eliminate, but the other two sources may be evaluated by a remote television inspection of the collection system and evaluation of all manholes to insure that they are watertight and are high enough to prevent storm water from flowing into them.

Present costs for remote television inspections are approximately $1.30 per lineal foot. This includes costs of minor repairs that can be corrected by grouting the inside of the pipe. If required, a project for major repairs can be developed based upon information gained in the inspection. It is also probable that remote television inspection will locate possible cross connections which allow tidal waters from the storm drains to back into the sanitary sewer lines.

Inspection of the domestic wastewater collection system is desirable because reduction of the wastewater flow will reduce the service charge paid the NCSD and repair of sewer pipes now may preclude the requirement to replace them in the future.

C. Water Treatment Backwash Water

As previously noted all potable water is purchased from the City of Charleston. The City of Charleston's water treatment consists of pre and post chlorination, coagulation and filtration. After the water enters the Naval Base distribution system, it is sampled at five separate points and chlorine added to maintain a chlorine residual between 0.2 and 2.0 mg/1.

Backwash from three of the four swimming pools is discharged into the sanitary sewers. Plans are underway to connect the backwash from the fourth pool into the sanitary sewer. Environmental Protection Agency's limitation of discharges from swimming pools into surface drainage system is a maximum of 40 mg/1 for suspended solids and 0.2 mg/1 for chlorine residual. Discharges from swimming pools are required to be monitored for flow daily, pH weekly, suspended solids monthly and chlorine residual monthly. Accordingly, to avoid the need for separate treatment and monitoring, the backwash water must be discharged into the sanitary sewer. This connection should have an air gap to avoid hydraulic backing up of sewage in the pool.

All pools are provided with pressure gauges at inlets and outlets to filters, a recirculation control vacuum switch is provided, rate of flow indicators are provided at outlet lines of filters. Test kits for residual chlorine and pH are provided for each pool. All pools have diatomaceous earth filters except pool no. 92 which has a sand/gravel filter. Pool no. 92 is being converted into an indoor pool. Pool no. 92 has a capacity of

529 swimmers, pool 639 (CPO pool) has a capacity of 340 swimmers, pool 184 (Officer's pool) has a capacity of 216 swimmers and pool NS59 has a capacity of 662 swimmers.

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D. FIREFIGHTING TRAINING AREA

The Fleet Training Center's firefighting school is operated to train Navy personnel in the techniques of firefighting under simulated fire conditions. The school is operated Monday through Friday on a year-round basis. Firefighting training requiring the combustion of fuels to simulate fire conditions is conducted in a period of time of less than 2 hours per day and is accomplished between the hours of 9 a.m. and 3 p.m.

The following types and quantities of fuels are normally used over the period of one year.

Distillate No. 2 Fuel Oil	-	75,000 gallons
Motor Gasoline	-	10,000 gallons
Liquid Propane Gas	-	450 lbs.

As noted in reference (c), Military Construction Project P-703 has been funded at an estimated cost of 1.9 million dollars for design by Contract N00025-74-C-0004, Firefighting School Smoke Abatement, criteria has been developed for design of smoke abatement systems for Fleet Training Center Fire Fighting Schools. Since FTC Fire Fighting School Abatement projects are required at Norfolk, Charleston and Mayport, a standard design is being developed for FTC Norfolk, Virginia, which will be the site adopted for the Fleet Training Center, Charleston. At this date the design contract is 60% complete and construction for the Norfolk Fire Fighting School is scheduled to begin 15 May 1976.

During the survey it was noted that the oil-water separator for the Fire Fighting School was not operating properly and that the overflow line to the Cooper River was closed within the oil-water separator. Since the drainage area of the oil-water separator is extensive, the rainfall runoff is large in volume and should be bypassed to the Cooper River rather than overloading the oil-water separator and flowing into the sanitary sewer. With the overflow line to the Cooper River closed, there exists a major source of infiltration into the sanitary sewer collection system during rainy weather. It is also necessary to prevent the Cooper River from backing into the oil-water separator during unusual "spring tide" conditions. AFFF, pK and protein foam are used during training.

E. BOILER PLANT DISCHARGES

One hundred and three (103) boilers serve the Naval Base, Charleston, S.C. The boilers blowdown lines as well as the floor drains discharge into the waste water collection system.

In the past the sanitary sewer system has accidently been contaminated with oil from a broken fuel line within the boiler plant. Public Works has learned from past experience that it is necessary to be aware of possible oil spills in the boiler plants which could result in oil contaminating the sanitary sewer collection system with resultant undesirable conditions and complaints from the City of North Charleston in connection with their treatment plant operation.

F. OIL POLLUTION PREVENTION

During the survey it was noted that an oil/water separator located at the south end of Building C-26 (a marine engine shop) discharges into the Cooper River. Since the discharge of solvents into adjacent rivers is not allowed, it is recommended that the discharge be connected to the sanitary sewer collection system.

G. INDUSTRIAL WASTE TREATMENT

The chrome waste treating facility, located adjacent to Ship 51 was visited. The facility was described as being undersized and would not operate properly in the automatic position. When the system is used, it is operated on a batch process basis and a Quality Assurance Chemist (Code 134) takes samples. At the time of the visit, fourteen (14) drums (55 gallons per drum) were full of chromate sludge. A request to have a contractor remove the material was being made. The former contractor was TRI-DENT SANITATION of Charleston. Cost of disposal is quite expensive and the cost is increasing. The disposal area formerly used by the contractor is the Ladson Landfill which is now closed. Plans are underway to replace and relocate the chrome waste treating facility to an area north of Building No. 3.

Also in the past, chrome (Cr_2O_3) and mercury wastes have been removed by the Gross Laboratories of Greer, S.C. At present the Berkeley County Landfill is being contacted in connection with disposal of heavy metal wastes.

Since disposal of heavy metal wastes is becoming a problem for the Charleston Naval Shipyard, Navy Environmental Support Office (NESO), by copy of this report, is being requested to furnish recommendations and guidance in connection with disposal of these wastes.

The battery shop was visited and it was noted that the battery cells are well sealed to prevent acid spills during the charging operations (up to 1500 amperes x 3 ea. at 400 volts). The cells are vented through the roof of the shop. Acid is stored in two 5,000 gallon glass lined vats and is mixed with distilled water in two additional glass lined vats. The distilled water is stored in two wooden vats. In the battery overhaul and acid waste treatment area, a tank (20 feet x 10 feet x 6 feet deep) is filled with acid, then neutralized with soda ash before it is drained into the domestic sewer system. Battery acid and rinse are drained into a concrete box with 8-inch walls and the wastes drained into neutralizing tanks. A small mixer is used when soda ash is dumped into the neutralizing tanks. A pH monitor had been installed but did not operate; therefore, litmus type paper was being used to determine when the end point is reached. To avoid future problems with the faulty pH meter, it is recommended that a double check with litmus paper be made before and after neutralization of the acid.

V. SOLID WASTE DISPOSAL

The Naval Base disposes of solid waste by two methods as follows:

1. Solid waste is delivered by the Navy at a rate of approximately 100 tons per day, 5 days per week to the Charleston County waste disposal facility for disposal. For services furnished under contract N62467-74-C-1804, the government pays the Charleston County at a rate of $2.37 per ton of solid waste delivered to the county's solid waste disposal plant located at Romney and America Streets, Charleston, S.C. The Charleston County Waste Disposal Facility is operated in compliance with the Environmental Health and Sanitary Regulations of the Public Health and Environmental Authorities and shall have received all approved operating permits, approvals and variances required by the law.

In connection with solid waste disposal, a Solid Waste Transfer Station is being designed by A/E Contract N62467-76-C-0131. At present a letter is being prepared by the Charleston Naval Shipyard Public Works outlining the requirements for the waste transfer station.

2. Solid waste from the Naval Base housing area (MOQ's and Marine), Commissioned Officer's Club, Golf Shop (Bldg. 1261), Navy Exchange (Bldg. 656) and Navy Exchange Warehouse (Bldg. 1198) is disposed of by Contract N62467-74-B-0486 with the TRIDENT SANITATION SERVICES, INC. of Charleston, S.C. Under the terms of the contract, the contractor furnishes all labor, transportation, materials, equipment and supervision necessary to perform the collection and disposal of garbage, refuse and trash. Under the same contract TRIDENT SANITATION SERVICE, INC., also collects and disposes of solid wastes of the Naval Weapons Station, Charleston.

Navy Civil Engineering Laboratory conducted a survey in 1974 evaluating the Charleston Naval Shipyard Solid Waste System and has developed a report addressing the possibility of solid waste disposal in a refuse derived fuel system.

The former landfill site and area which is used for a wood "give away" program was visited. It is realized that giving away wood (boards, wood pallets, etc.) can be a problem. The area is aesthelically unpleasing

SANITARY ENGINEERING GUIDE FOR BOILER WATER TREATMENT CHECK SERVICE

1. Information. NAVFACINST 11330.9 provides information concerning services furnished by the Bureau of Mines (BUMINES) including monthly boiler water and condensate sample testing. This service is being used by most boiler plant operators at naval activities to compare results of their tests with those obtained under controlled conditions by another laboratory. This type of service is similar to that used by public and private utilities. Differences between plant and laboratory results usually indicate need for modification of the operators' test procedures and/or updating of test reagents. This verification of local test results is essential to insure the adequacy of local treatment. Experience has shown several instances of major tube failures in spite of local test results indicating no chemical problems with the water. Utilization of the BUMINES laboratories to confirm local testing is prudent and most strongly recommended. Upon request from an activity, BUMINES will provide sample bottles, pipe tests sections and testing at no cost to the activity.

2. Procedures. Addressees should collect and submit boiler water and condensate check samples and condensate line corrosion test sections to BUMINES as follows:

a. Procuring and shipping of sample bottles. Request the number of bottles necessary from BUMINES to implement boiler water testing program. One pint bottle is required for each sample (boiler water and condensate). The bottles require no special packing and should be returned to BUMINES in the container as received, after sampling, to:

U. S. Department of the Interior
Bureau of Mines, Boiler Water Service
College Park, Maryland 20740

b. Sampling. One sample of boiler water and one sample of condensate should be submitted monthly for one shore-based steam boiler plant operating over 15 psig pressure. Activities having steam boilers operating under 15 psig and who are treating the boiler water should submit one sample semiannually. Activities using contract boiler water testing and treatment services or any other testing service approved by SOUTHNAVFACENGCOM should submit samples to BUMINES quarterly.

c. Procuring and installing of corrosion test sections. Condensate line corrosion test sections should be requested from BUMINES and installed at the start of each heating season. The test sections come with installation instructions which should be followed very closely. A corrosion test section should be placed in each major condensate return system. The number of test sections installed should be based on size of system, the number of return runs, and previous corrosion problems.

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d. Required tests

(1) By plant operator. Where possible, the plant operator should conduct tests for causticity, total dissolved solids (TDS), phosphate, sodium sulfite (if used) and tannin on the boiler water check samples to be submitted in accordance with paragraph 4.b above. Also, conduct pH, hardness and specific conductance tests on the condensate sample. Record results in pencil on NAVFAC Form 1470, "Report of Boiler Water Check Sample," original and one copy. Enclose the completed form with the sample.

(2) By BUMINES Laboratory. This laboratory will perform check tests for causticity, TDS, phosphate sulfite (as received) and tannin (where applicable) on the boiler water sample and will record its results opposite the operator's results on NAVFAC Form 1470. The laboratory will perform pH, hardness and specific conductance tests on the condensate sample and report results. The original of the completed NAVFAC Form 1470, together with sample bottles for the next submission, will be returned promptly to the activity. The condensate line corrosion test sections will be evaluated as to the type, cause and rate of corrosion. Copies of reports will be forwarded to SOUTHNAVFACENGCOM for review and comment on the adequacy of the boiler water treatment program.

e. Action by activity on results of tests. Immediately upon receipt of the laboratory reports on boiler water and condensate, the operator should compare his results with the laboratory results. If there is significant difference between these results, the operator should take action to insure that his testing procedures are in conformance with the instructions furnished with the test kits or as modified by SOUTHNAVFACENGCOM Adjustment in feedwater treatment may be indicated by reports on corrosion test sections.

f. Test equipment. Necessary chemical reagents, test kits for performing daily boiler water tests, and condensate corrosion test sections may be obtained directly from BUMINES at no cost to the activity. Form BWS 6, available from BUMINES, will be used for this purpose.

3. Form Availability. NAVFAC Form 1470 may be obtained from cognizance symbol 1I stock points under stock number 0105-009-0000 in accordance with NAVSUP P2002. All check samples submitted to BUMINES must be accompanied by this form.

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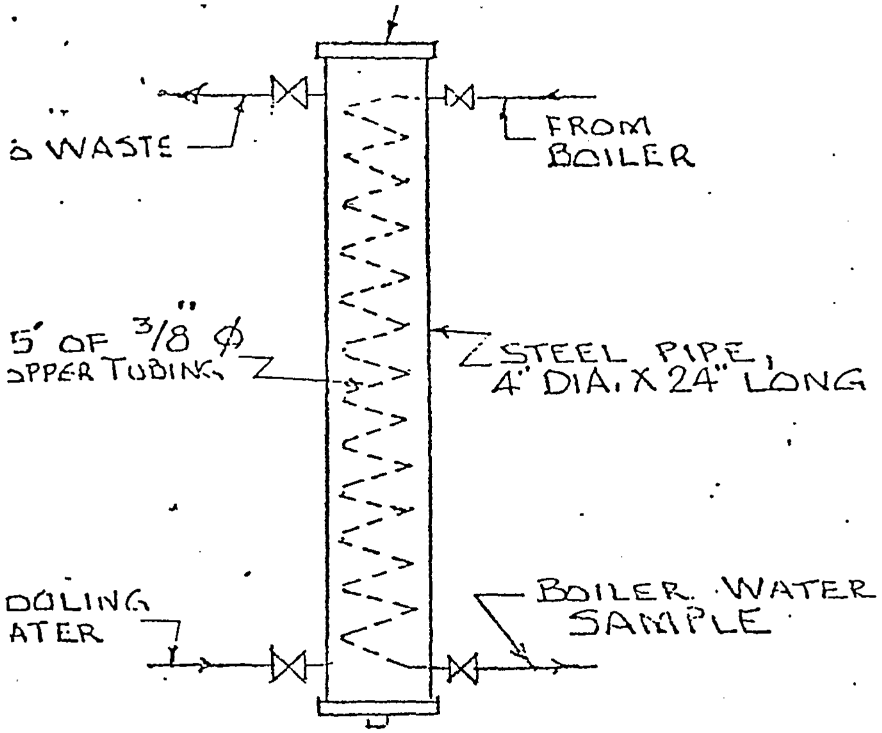
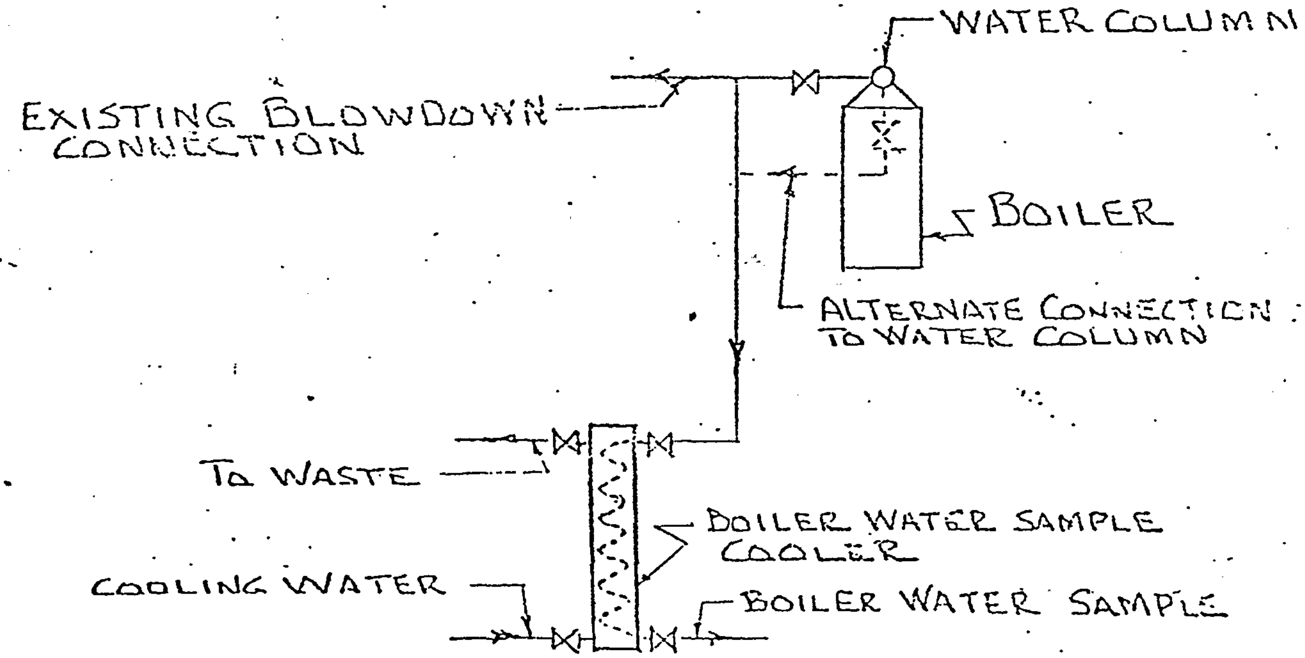


BOILER WATER SAMPLE COOLER

NOT TO SCALE



SKETCH SHOWING METHOD OF CONNECTING BOILER WATER SAMPLE COOLER

N. T. S.

BOILER WATER SAMPLE COOLER & COOLER PIPING CONNECTIONS

J.D.M. 2-26-75

APPENDIX

SANITARY ENGINEERING GUIDE FOR
COOLING TOWER WATER TREATMENT

1. General. Cooling tower water treatment has two main objectives. The first, scale and corrosion control, is necessary to protect the cooling tower, heat exchanger and piping from scale deposits and corrosion. Scale will decrease the effectiveness of the heat exchanger and decrease the effective size of pipes. Corrosion will cause early failure of metal surfaces, especially in the heat exchanger tubes. The second, algaecide treatment, controls the growth of algae in the cooling tower. This is important because the algae will clog the cooling tower and decrease its efficiency. Appendix A is a technical guide for use in contracts specification

2. Bureau of Mines Assistance. The treatment program presented in this manual is based upon treatment practices of the Bureau of Mines Industrial Cooling Water Treatment Service which provides recommendations for cooling tower treatment for naval activities under NAVFAC Instruction 11330.10. The Bureau of Mines provides analysis of bleedoff water samples and treatment recommendations at no cost to the activity.

3. Glossary

Algae - A slime that grows on cooling towers which is most often green. The term is used in the general sense and not the strict scientific sense and includes all biological growths.

Algaecide - A substance used to kill algae.

Bleedoff Water - Water which is discharged from the cooling tower system to control the stability of the circulation water.

Circulation Water - Water in the cooling tower system which circulates between the cooling tower and the condenser.

Concentration - The number of times the dissolved solids in the circulation water are more concentrated than those in the makeup water, expressed as a ratio.

Condenser - Where heat enters the cooling water system and leaves the refrigerant system.

Conductivity - An indirect measurement of the dissolved solids concentration which is based upon the ability of water to conduct electricity.

Cooling Tower - Where heat leaves the cooling tower system due to evaporation of a portion of the circulation water.

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Corrosion - Deterioration of metal surfaces; when the metal dissolves in water.

Makeup Water - Water which enters the cooling tower system to replace water lost due to bleedoff, evaporation and windage losses.

Scale - Deposits of solids in the cooling tower system which usually result from the circulation water being high in total dissolved solids.

Windage Losses - Water lost from the cooling tower due to wind blowing water away from the cooling tower.

4. Cooling Tower Treatment Principles

Figure I provides a schematic sketch of a typical cooling tower system. Most makeup water is obtained from treated river or well water which may be either soft and corrosive or hard and scale forming. As this water is circulated through a cooling tower it becomes concentrated due to evaporation. If the makeup water is corrosive, increasing the concentrations causes the water to become less corrosive and a point is reached where the water stabilizes. As the concentration of dissolved solids further increases, the water begins to have more scale forming tendency. The scale forming tendency continues to increase as the cooling tower water becomes more concentrated.

To prevent scale and corrosion in the cooling tower system, the dissolved solids concentration in the circulating water is maintained at the concentration where the water is stabilized (at equilibrium). Assuming the makeup water has a constant chemical character, this is accomplished by setting the bleedwater rate from the cooling tower so that the evaporation which concentrates the water is balanced by bleeding water from the tower. Too high a bleed rate will cause too low a dissolved solids concentration. Too low a bleed rate will cause too high a dissolved solids concentration. Since the bleed rate is to compensate for evaporation, higher bleed rates are required during hot weather when evaporation is greatest.

Chemicals are added to the cooling tower circulation water to assist in the prevention of scale and corrosion. This is necessary because the water will not always be exactly stable. The chemicals have the property of preventing scale and corrosion when the water is relatively close to a stable condition and reducing bleedoff requirements.

Algae will grow in the cooling towers especially when the tower is exposed to sunlight. To prevent the growth of algae, algaecides should be fed to the recirculating water as required.

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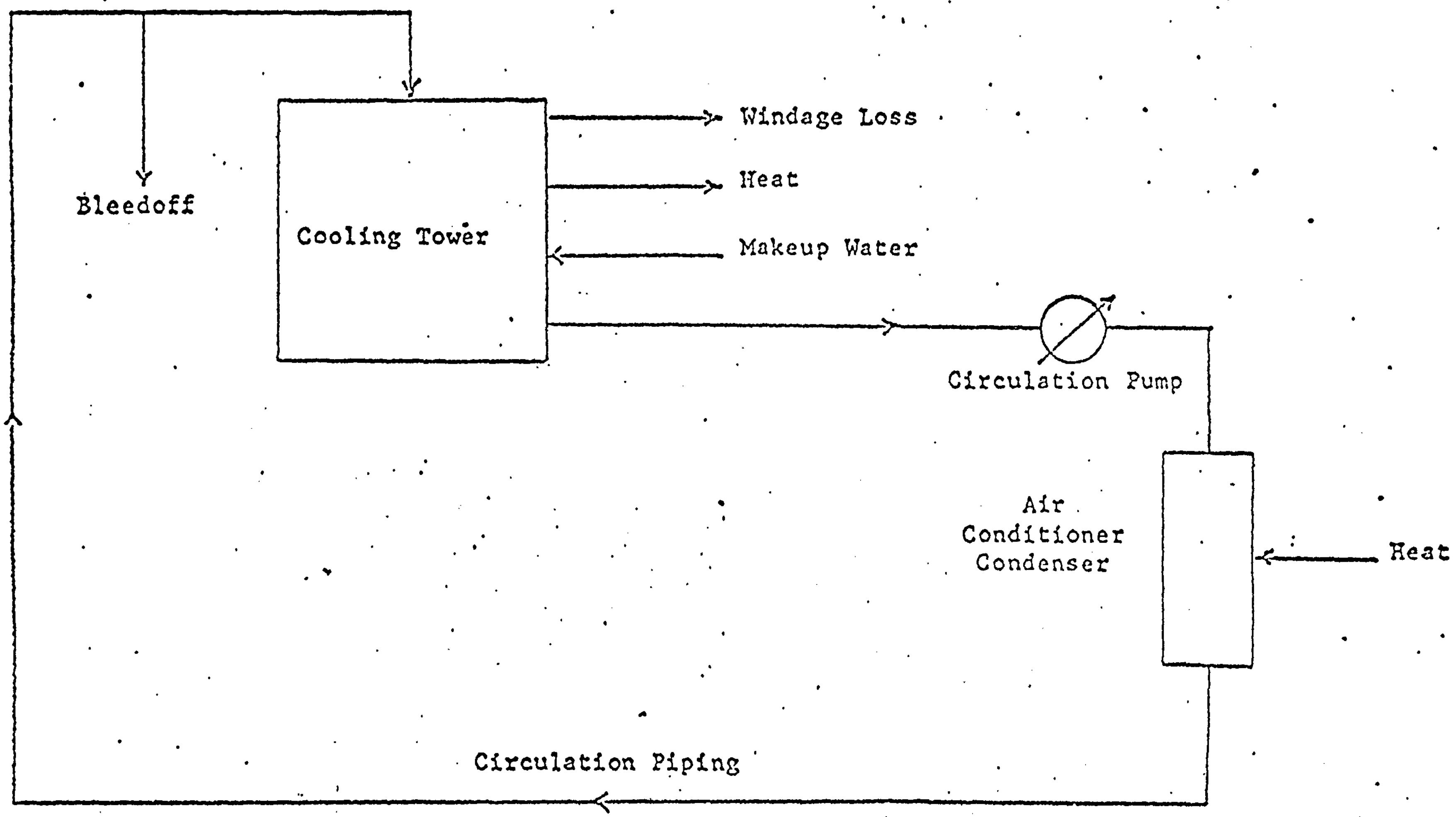

COOLING TOWER SYSTEM
SCHEMATIC DIAGRAM

FIGURE 1

5. Bleedoff Rate Control

Bleedoff water from cooling tower systems usually is discharged from circulation pipes between the air conditioner condenser and the cooling tower rather than from the tower sump. This arrangement is preferable because bleedoff water will not flow whe the cooling tower circulating pump is not in operation, thus wasting water and reducing the stability of the water. Some of the older cooling towers have their bleedoff line discharging from the cooling tower pan. This results in bleedoff water flowing even when the cooling tower is not in operation. An ideal location for the bleedoff line is at the high area of the circulation piping just ahead of the cooling tower inlet manifold above the water level in the tower sump. This location does not result in water being wasted and puts the bleedoff control valve convenient for adjustment when the cooling tower is inspected.

The bleedoff water rate may be used to maintain the circulation water at a stable condition with respect to scale and corrosion control. When makeup water is added, if the bleedoff rate is too high, the total dissolved solids concentration decreases and the water becomes corrosive and its use is excessive. If the bleedoff rate is too low, the total dissolved solids concentration will increase and the water will have a scale forming tendency. However, control of scale and corrosion by bleedoff alone, without water treatment, is usually uneconomical.

The bleedoff rate for a cooling tower system depends upon the characteristics of the makeup water, the system's size and daily weather conditions. The number of times the makeup water may be concentrated depends upon the makeup water characteristics and must be determined by a chemical analysis. The cooling tower system's size affects the required bleedoff rate in that larger systems require high bleedoff rates because they have larger evaporation rates. Weather conditions affect required bleedoff rates because during warmer weather more evaporative cooling is required and the bleedoff rate must be higher.

The required bleedoff rate may be approximated by the following equation:

$$B = \frac{3\ T}{100\ (C-1)} \qquad (1)$$

B = Bleedoff rate, gpm

T = Tons of air conditioning served

C = Concentration of the circulation water

Equation (1) is based upon a 10°F temperature differential between the inlet and outlet of the cooling tower, air conditioner coefficient of performance of 3.2, and a 1:4 windage loss to bleedoff ratio.

The bleedoff rate predicted by equation (1) is a point of departure because the equation is based upon average conditions. Variations in weather conditions, air conditioner efficiency and windage losses will require adjustment of the bleedoff rate. Also, steam absorption units require about twice the bleedoff rate predicted by equation (1).

After 24 hours, the concentration of the circulation water should be checked to insure that it is at the proper value. If the concentration is too high, the bleedoff rate should be increased. If the concentration is too low, the bleedoff rate should be decreased.

The amount of makeup water entering the system can be estimated by the following equation:

$$M = \frac{TC}{100\ (C-1)} \qquad (2)$$

M = Makeup water flow, gpm

T = Tons of air conditioning served

C = Concentration of the circulation water

Equation (2) is based upon a 10°F temperature differential between the inlet and outlet of the cooling tower, air conditioner coefficient of performance of 3.2 and 1:4 windage loss to bleedoff ratio.

For steam absorption air conditioning units the makeup water flow rate predicted by equation (2) must be doubled.

6. Circulation Water Concentration Measurement

The concentration of cooling tower circulation water may be determined by three different parameters: total dissolved solids, chlorides, and conductivity. Measurement of the total dissolved solids provides a precise determination of the circulation water concentration, but a well equipped laboratory is required to make the test. Consequently, total dissolved solids are measured when cooling tower system treatment programs are initiated, but the test is too cumbersome for day-to-day use.

Chlorides can be measured in five or six minutes with an inexpensive field test kit. The chloride ion is present in most water supplies and is very soluable so it is useful for determining circulation water concentrati in small cooling tower systems.

For daily work, concentration is most often determined by measuring the conductivity of the circulation water. Conductivity is directly related to total dissolved solids and can be measured instantaneously with an inexpensive meter. For large cooling tower systems, permanent conductivity meters are often used to control automatic bleedoff control valves. Information on suitable chloride test kits and conductivity meters are described in Section XII.

7. Scale and Corrosion Control

a. General. Water treatment program for scale, corrosion and algae control may be accomplished by (1) station forces using either federal stock chemicals and commercial feeders, (2) station forces using commercial chemicals and feeders, (3) contract for chemicals, feeders and technical service with station force operation and (4) contractor providing all labor and materials. Usually method (3) is employed to minimize labor costs at large activities and method (4) is employed at small activities where limited technical personnel are available, e.g. Reserve Training Centers. Appendix A is attached hereto for use as a guide where it is desired to accomplish all or part of this program by contract.

b. By Station Forces. The following procedures may be followed where all government labor and material is used.

Sodium hexametaphosphate should be fed to cooling tower circulation water to provide scale and corrosion protection. For the phosphate to be effective, the concentration of the water should be adjusted to help maintain its stability with respect to scale and corrosion. Under this condition a slight scale forming condition exists which can be readily controlled by the phosphate. Corrosion is also reduced by the phosphate film on metal surfaces.

The chemical concentration should be maintained between 20 mg/1 and 30 mg/1 as phosphate in the circulation water. Sodium hexametaphosphate is available through the Federal Supply Service, FSN 6810-531-7805, in the glassy bead or plate form as 67% polyphosphate. This requires 1/3 pound of phosphate beads or plates per 1,000 gallons of water for 30 mg/1 total phosphate.

When initiating the phosphate treatment, a shot of phosphate should be fed to the system to raise the polyphosphate concentration to 60 mg/1. This will require 2/3 pound of phosphate beads or plates per 1,000 gallons of water in the cooling tower system. The total phosphate should then be monitored until it drops below 30 mg/1. It should then be maintained between 20 mg/1 and 30 mg/1.

Phosphate can be continuously fed to cooling tower systems in the liquid form with chemical feed pumps or by suspending the phosphate glassy beads in the circulation water where it can dissolve. Concentrated solutions can be made by dissolving 1 to 3 pounds of plate polyphosphate per gallon in a chemical holding tank. Hot water is often required to dissolve the phosphate. The concentrated solution should be pumped into the circulating water. The chemical feed pump should be set to feed 1/3 pound of phosphate per 1,000 gallons of makeup water that enters the cooling tower system.

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The solution tank should be sized to hold the phosphate required for nine days of operation. The chemical feed pump should be controlled by a timer and be capable of accurately feeding the required amount of chemicals.

Cooling towers which serve less than 150 tons of air conditioning do not require a sufficient amount of phosphate to justify the installation of chemical feed equipment. For the smaller systems sodium hexametaphosphate in the glassy bead form can be suspended in the cooling tower pan in a flow through cloth bag. Five pounds of phosphate beads per 25 tons of air conditioning served will maintain about 20 mg/l of total phosphate in the circulation water. The bags should be inspected weekly and refilled when half of the beads dissolve away.

Total phosphate should be monitored in the cooling tower system circulation water. If the phosphate level is above 30 mg/l, the amount of phosphate fed should be decreased. If the phosphate concentration is below 20 mg/l, the amount of phosphate fed should be increased.

8. Algaecide Application. Chemical algaecides should be applied to cooling towers on an as needed basis. Algae is a greater problem in cooling towers located in direct sunlight than in those located in shady areas because algae is largely dependent upon sunlight for growth. When it is feasible, covering cooling towers provide a very effective means for reducing algae problems in towers.

When shading a cooling tower does not provide adequate algae protection, an algaecide should be fed to the tower on an as required basis. Only commercial algaecides registered with the Environmental Protection Agency under Federal Insecticide, Fungicide and Rodenticide Act (as amended) should be used. The algaecide should be registered specifically for use in cooling towers and should only be used as specified on its label. Algaecides which are suitable for use in cooling towers are readily available through water treatment product suppliers.

9. Cooling Tower System Treatment Equipment (For Contract or Station Force Operation)

a. Automatic Bleedoff Control. Automatic bleedoff control consists of a conductivity meter sensor, immersed in the cooling tower system circulation water, which controls a solenoid bleedoff valve. The bleedoff

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controller opens the solenoid valve when the conductivity of the circulation water reaches the upper limit of the desired range and closes the valve when the conductivity reaches the lower limit of the desired range.

Automatic bleedoff control systems can be installed on any cooling tower system, but is of marginal value on systems which serve less than fifty tons.

b. Automatic Bleedoff and Chemical Feed Control. Automatic bleedoff and chemical feed control systems are similar to automatic bleedoff control systems except that the chemical feed pump feeds the chemical solution in proportion to the amount of makeup water that enters the system. This system provides excellent control over the amount of treatment chemicals in the circulation water because the chemical concentrations in the bleedoff water are more uniform. The system is suitable for cooling tower systems which serve more than 150 tons, but is usually used on systems serving 250 tons or more.

c. Semiautomatic Chemical Feed Control. Semiautomatic chemical feed control consists of a chemical feed pump and solution tank which are controlled by a timer. Setting the pumping rate and periods of operation of the pump controls the amount of treatment chemicals fed each day. This amount is determined by calculating the amount of chemicals lost through bleedoff and adjusting the chemical feed rate to maintain their proper chemical level in the circulation water. This control system is usually used in cooling tower systems which serve greater than 100 tons of refrigeration.

10. Cleaning of Cooling Tower Systems

a. New Systems. Before placing a new cooling tower system in operation, it should be thoroughly flushed out to remove debris, grease and corrosion products. Common materials used for cleaning are trisodium phosphate, sodium carbonate and sodium hydroxide. The following solution strengths are recommended: trisodium phosphate and sodium hydroxide -- one pound per fifty gallons of water in the circulation system; and sodium carbonate - one pound per thirty gallons of water. The solution should be circulated in the cooling tower system for four hours or as recommended by the equipment manufacturer. After cleaning, the system should be drained, flushed, refilled with fresh water and placed in operation. Scale and corrosion treatment and bleedoff control should be started immediately.

b. Old Systems. Cooling water systems which have been in service for some time and have accumulated scale or corrosion products, as indicated by increased temperature or pressure differential through the condensers, should be thoroughly cleaned out by chemical and/or mechanical means. Chemical cleaners (available through Federal Stock) usually consist of powdered acid (sulphamic acid), a corrosion inhibitor, a wetting agent and pH indicator. Instructions of the chemical manufacturer (outside of package) on the use of the particular cleaner should be carefully followed. Too high a chemical dosage, too long an application or insufficient neutralization could accelerate corrosion of the system.

Mechanical cleaning of condenser tubes may be necessary. This may be accomplished with rotary cutters or wire brushes. After cleaning, the system should be drained, flushed, refilled with fresh water and placed in operation. Cooling tower treatment should be resumed immediately.

11. Test Sections. To allow evaluation of the effectiveness and adjustment of the treatment program, install a new, clean 1 or 1½-inch line, on one of the towers, taking off from the main pipe to the cooling tower and discharging into the tower separately. This line should be equipped with a valve, so that the velocity of water through it can be adjusted to approximately that of the principal flow. Two unions should be installed between the valve and the cooling tower to receive a 6 to 10-inch nipple. The nipple should be of the same material as the main cooling tower piping. The nipple should be left in the test line for about 90 days, and then sent to the Bureau of Mines for evaluation of the effectiveness of the treatment program. Further instructions on this procedure should be obtained from:

U. S. Department of Interior
Bureau of Mines
Boiler Water Service
College Park, MD 20740

12. Cooling Tower System Test Equipment. Test equipment and procedure should be similar to the following which is available from HACH Chemical Company, Box 907, Ames, Iowa 50010.

Conductivity Meter

HACH Conductivity Meter
Model 2510
Price: $225
Power Requirement: 8 ZM9 1.4 volt mercury cells
Battery Life: Approximately 500 hours

Phosphate Measurement Kit

HACH Orthophosphate Kit
Model PO-19
Price: $21
Range: 0-50 mg/l

TO BE USED FOR SAMPLE PURPOSES ONLY

TECHNICAL PROVISIONS
FOR INCLUSION IN
COOLING TOWER SYSTEM WATER TREATMENT
SPECIFICATIONS

SECTION X. TECHNICAL PROVISIONS FOR COOLING TOWER SYSTEM WATER TREATMENT

X.1. General. Furnish technical services and materials for treatment of the station's cooling tower systems to prevent scale, corrosion and biological growths.

X.2. Makeup Water Characteristics. Makeup water comes from the station's potable water source which has the following analysis:

pH	________
Color	________
Turbidity	________
P Alkalinity	________
MO Alkalinity	________
Total Hardness	________
Non-Carbonate Hardness	________
Carbonate Hardness	________
Total Dissolved Solids	________
Specific Conductance	________
Calcium	________
Magnesium	________
Sodium	________
Potassium	________
Hydroxide	________
Bicarbonate	________
Carbonate	________
Sulfate	________
Chloride	________
Nitrate	________
Iron	________
Maganese	________
Silica	________
Fluoride	________
Chlorine Residual	________

The contractor shall verify the above analysis.

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X.3. Systems Treated. The following cooling tower systems shall be treated as indicated

Bldg. No.	Cooling Load Tons	Compressor Unit	Steam Absorption Unit	Treatment Equipment	Coupon Corrosi Test Requirec
Example					
8	25	X		d	X
10	100		X	c2	X
18	275	X		b1	X
20	275	X		b2	X

KEY

a. Automatic Bleedoff Control (consider on systems 50 tons & lar
b. Automatic Bleedoff and Chemical Feed Control (consider for systems 150 tons and larger)
c. Semiautomatic Chemical Feed Control (consider on systems larger than 100 tons)
d. Manual Control (consider on systems under 50 tons)

1. Supplied by contractor
2. Furnished by government

X.4. Environmental Protection. The treatment program used shall be such that bleedoff water and other discharges from the cooling tower system will be suitable for discharge directly into the natural drainage system without any detrimental impact upon the receiving stream quality or violating any applicable federal, state or local pollution abatement regulation or law.

X.4.1. Scale and Corrosion Prevention Chemicals. The following limitations shall be satisfied in the absence of applicable regulations. Hexavalent chromium shall not exceed 0.1 mg/l, zinc shall not exceed 1.0 mg/l, copper shall not exceed 1.0 mg/l, chlorine residual shall not exceed .2 mg/l and the pH shall be between 6.0 and 9.0 in bleedoff water from the cooling towers.

X.4.2. Algaecides. Algaecides used shall be registered with the Environmental Protection Agency under the Federal Insecticide, Fungicide and Rodenticide Act, as amended (7 U.S.C. 136 (et seq.)) specifically for use in cooling towers. The algaecide shall be used as specified on its label. Before any algaecide is used, the contractor shall furnish the Officer in Charge of Construction a specimen label with the product's registration number and application instructions.

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X.5 Cleaning. The contractor shall flush and clean all cooling towers of scale, trash, mud, dirt, algae, slime and other foreign material within 15 days of the effective date of the contract and before the introduction of the water treatment chemicals to the system.

X.6 Water Treatment. The contractor shall furnish the labor, material (including chemicals) and equipment to treat the cooling tower circulation water. Essentially, treatment shall consist of the following:

X.6.1 Consistent control of the circulation waters so that its concentration ratio is within the range that the chemical treatment program provided will adequately control scale and corrosion. A concentration ratio of at least 1.5 should be maintained.

X.6.2. Prevention of scaling and corrosion on waterside surfaces of condensers and cooling water piping. Corrosion shall not exceed 2 mils penetration per year (mpy) as shown by use of test coupons in Section X.10.2.

X.6.3. Prevention of accumulations of trash, mud, dirt and precipitate in the cooling water system.

X.6.4. Elimination of algae and biological growth in the cooling tower.

X.6.5. The treatment shall not cause deterioration of wood or metal components of the cooling tower system.

X.7. Treatment Equipment. Cooling tower system treatment equipment shall be furnished by the contractor as specified in Section X.3.

X.7.1. Automatic Bleedoff Control. Automatic bleedoff control shall consist of a permanently installed conductivity meter which monitors the circulation water and automatically activates a remote controlled bleedoff valve which maintains the concentration ratio of the circulation water within the limits specified in Section X.6.1.

X.7.2 Automatic Bleedoff and Chemical Feed Control. Automatic bleedoff and chemical feed control shall consist of conductivity meter which controls both the bleedoff and chemical feed of the cooling tower system. The bleedoff shall be controlled to maintain the concentration ratio as specified in Section X.6.1. The chemical feed shall be controlled so that the proper amount of chemicals are automatically fed to replace those lost through bleedoff.

X.7.3 Semiautomatic Chemical Feed Control. Semiautomatic chemical feed control shall consist of a chemical feed system which is controlled by a variable timer.

X.7.4 Manual Control. Manual control consists of a manually controlled bleedoff valve and the use of slow dissolving chemicals to maintain proper levels of scale and corrosion prevention chemicals.

X.8. Chemical Feeding and Bleedoff Control Equipment Installation. All chemical feeding equipment which is supplied by the contractor shall be installed in a location designated by the contracting officer. Shop drawings of chemical feeding equipment shall be approved by the contracting officer.

X.8.1 Pumps. Pumps shall have a capacity which is compatible with the chemical feed requirements of the individual cooling tower system served. The chemical feed rate should be variable over a range that will meet all the cooling system requirements. Adjustments necessary to accomplish capacity control shall be simple and positive. The pump shall be of noncorrosive construction and shall have an internal checking device or shall be provided with an externally mounted noncorrosive check valve. The pump shall be capable of discharging against a pressure of not less than 1½ times the line pressure at the point of connection. The pump shall be driven by a 120 volt, single phase, 60 cycle, open drip-proof gear-head type, electric motor.

X.8.2 Pump Operation. When required, the pump operation shall be controlled by an automatic adjustment which will proportionate the chemical feed at a step rate in accordance with the bleedoff rate. In addition, a manual switch shall be provided for the pump to allow control of the pump independent of the feeding regulator.

X.8.3 Chemical Solution Tank. Chemical solution tanks shall be constructed of noncorrosive material, be cylindrical in shape with a hinged cover. The tank shall have a sufficient capacity to require recharging only once per seven days during normal operation. The charging concentration chosen shall be such as to prevent deterioration of the chemical solution during the seven day period and prevent concentration of ingredients in the chemical solution. The tank shall be provided with a valved cold water line and, if necessary, a valved hot water fill line with a suitable air gap. The tank shall have a graduated sight glass or have other suitable device to indicate the quantity of solution in the tank. In addition, the tank shall be equipped with a suitable removable perforated noncorrosive basket for dissolving chemicals in the tank. A suitable electric mixing device shall be provided with the tank.

X.8.4 Automatic Bleedoff Control. Automatic bleedoff control shall consist of a conductivity meter that monitors the circulation water and controls a solenoid valve that regulates bleedoff water to maintain the concentration as given in Section X.6.1.

X.8.4.a. Conductivity Meter. The conductivity meter shall be complete with an immersible sensor to continuously monitor the circulation water, shall have temperature compensation, no mechanical moving parts and operate on the square wave generator principle eliminating quadrature error effects. The sensor shall consist of epoxy insulated carbon electrodes and shall not require platinizing. The meter shall have a visual readout, set point adjustment with a range between 200 micromhs/cm and 4,000 micromhs/cm and a red pilot light indicating basin water conductivity above set point. The unit shall operate from a 120 volt, single phase, 60 hertz power source.

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X.8.4.b. Solenoid Valve. The solenoid valve should be equipped with a 120 volt, 60 hertz water proof solenoid coil and be rated at 125 psig and 180°F. The valve shall have a brass body and stainless steel wetted surfaces rated at 125 psig and 180°F.

X.9. Treatment Program. The successful bidder shall submit to the contracting officer, and obtain his approval, prior to commencement of service, the program outlining the procedure he proposes to follow in accomplishing the work specified herein. The program shall state (1) the amount, type, methods of feeding and controlling of chemicals to be used and (2) the number and method of controlling the concentrations to be maintained in the circulation water. Shipping, handling and storage instructions shall be furnished with the program outline. Shop drawings of the corrosion tester installation shall be approved by the contracting officer.

X.10. Treatment Control. The contractor shall monitor the treatment throughout the duration of the contract.

X.10.1 Circulation Water Testing. The contractor shall test the circulation water from each cooling tower system treated at least once per month for pH, conductivity, treatment chemical residual and specific substances used for treatment that present a pollution hazard when present above a certain level. Substances that present a pollution problem include, but are not limited to, chromium, copper and phenols. Potentially polluting substances not used in the treatment program need not be monitored. Chemical tests shall be done in accordance with "Standard Methods for the Examination of Water and Wastewater," 13th Edition, 1971, or a test kit based upon "Standard Methods." Analysis reports shall be presented to the contracting officer.

X.10.2 Corrosion Testing. Corrosion testing shall be in accordance with ASTM, D2688-70, Method B, "Standard Methods of Test for CORROSIVITY OF WATER IN THE ABSENCE OF HEAT TRANSFER, COUPON TEST." Coupons shall be installed in the cooling tower system as is depicted in Figure 3 of the ASTM D2688-70. The coupons shall be installed at the beginning of the contract and replaced every 90 days. The coupons shall be prepared and tested by an independent testing laboratory suitable to the contracting officer. The laboratory report shall be presented to the contracting officer and (for each coupon) shall include the corrosion rate in mils penetration per year (mpy) and a verbal description based upon ASTM, D2688-70, paragraph 5.

X.11. Duration of the Contract. The contract shall become effective (date) and shall be applicable to all services performed hereunder through (date) .

X.12. Required Laboratory Facilities. All work shall be performed by a contractor who has made arrangements with a certified water testing laboratory acceptable to the contracting officer in the field. Evidence of this arrangement shall be submitted by the low bidder within five days after bid opening and prior to award. The contracting officer reserves the right to periodically collect and submit samples of the circulating water to an independent laboratory for analysis to check on the contractor's performance of the work.