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WHITE,L.D. Rochester Gas & Electric Corp.
RECIP.NAME RECIPIENT AFFILIATION
ZIEMANN,D.L. Operating Reactors Branch 2

SUBJECT: Forwards response to NRC 791022 request for evaluation of auxiliary feedwater sys & informs that addl info re auxiliary feedwater sys flow requirements will be forwarded in seven months.

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LEON D. WHITE, JR.
VICE PRESIDENT

TELEPHONE
AREA CODE 716 546-2700

November 28, 1979

Director of Nuclear Reactor Regulation
ATTN: Mr. Dennis Ziemann, Chief
Operating Reactors Branch #2
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: NRC Requirements for Auxiliary Feedwater Systems
R. E. Ginna Nuclear Power Plant
Docket No. 50-244

Dear Mr. Ziemann:

This letter is in response to a letter from Darrell Eisenhut dated October 22, 1979 and received October 29, 1979. The letter requested that we evaluate our auxiliary feedwater systems against the applicable requirements contained in Enclosure 1 to that letter. The letter also requested that we respond to a generic request for additional information regarding auxiliary feedwater system flow requirements contained in Enclosure 2 to that letter.

Enclosed with this letter is our response to the requirements of Enclosure 1. The information requested in Enclosure 2 will be provided in approximately seven months. We have contacted Westinghouse Electric Corporation and have been told that it will take approximately six (6) months for them to compile this information.

Sincerely yours,

L. D. White, Jr.

L. D. White, Jr.

Attachment

A039 S/1

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P

[illegible]

RESPONSE TO ENCLOSURE 1 TO OCTOBER 22, 1979 LETTER

NRC REQUIREMENTS FOR AUXILIARY FEEDWATER
SYSTEMS AT ROBERT E. GINNA NUCLEAR
POWER PLANT, UNIT 1

X.4.3.1 Short-Term

1. Recommendation GS-3 - The licensee has stated that it throttles AFW system flow to avoid water hammer. The licensee should reexamine the practice of throttling AFW system flow to avoid water hammer.

   The licensee should verify that the AFW system will supply on demand sufficient initial flow to the necessary steam generators to assure adequate decay heat removal following loss of main feedwater flow and a reactor trip from 100% power. In cases where this reevaluation results in an increase in initial AFW system flow, the licensee should provide sufficient information to demonstrate that the required initial AFW system flow will not result in plant damage due to water hammer.

RG&E Response

Upon 2/3 low low Level indication in either steam generator both motor driven AFW pumps start and deliver at least 200 gpm to their respective S/G's. Only the flow from one (1) AFW pump (200 gpm) is needed to remove decay heat. Development of the required flow is verified on a monthly basis through the performance of a Periodic Test (PT) procedure on all AFW Pumps.

The discharge valves on the motor driven AFW Pumps are automatically throttled to less than 230 gpm but more than 200 gpm upon pump start. Automatically throttling the valves conserves auxiliary feedwater and helps limit the cooldown when all the pumps start but is not done to avoid water hammer.

The short piping run from the feedwater header to the steam generator feed ring plus the installation of 'J' tubes on the steam generator feed ring has reduced the probability of water hammer. (See our letter to Mr. D. Ziemann dated June 15, 1978.)

Auxiliary feedwater flow is limited to less than 200 gpm to each steam generator (150 gpm each) only by operator action and only when a low-low steam generator level condition exists and no safety injection signal is present or during normal plant startup or shutdown when the AFW system is manually controlled in accordance with steam generator level. (See our letter to Robert A. Purple dated January 30, 1976.)

Therefore, the system will supply sufficient initial flow to the steam generators to assure adequate decay heat removal following loss of main feedwater flow and a reactor trip from 100% power.

2. Recommendation - The plant has AC dependent service water cooling of the lube oil for the turbine driven pump. The turbine driven feedwater pump has an AC lube oil pump and a DC lube oil pump. These pumps direct the oil through a heat exchanger which depends on the AC powered service water system pumps to cool the oil. In the event of a total loss of AC power, lube oil cooling capability for the turbine-driven pump will be lost due to the loss of AC power to the service water pumps. The turbine-driven pump could cease to function due to the loss of lube oil cooling. The as-built plant should be capable of providing the required AFW flow for at least two hours from one AFW pump train independent of any alternating current power source. Subsequent to this review, the licensee conducted a test to demonstrate that the turbine-driven pump could operate for two hours without lube oil cooling water flow. The test was run for one hour and 45 minutes with the final one hour and 15 minutes of the test with the pump at rated speed, but at 50% of required plant flow. Preliminary test results indicate the pump and turbine bearing temperatures remained within allowable limits. The staff is evaluating these test results to determine if the test data will support a conclusion that the required AFW flow can be provided independent of any AC power source. Until this evaluation is complete, interim emergency procedures should be established which provide for an individual to be stationed at the turbine-driven pump in the event of the loss of all alternating current power to monitor pump/turbine bearing and/or lube oil temperatures. If necessary, this operator would operate the turbine-driven pump in an on-off mode until alternating current power is restored. Adequate lighting powered by direct current power sources and communications at local stations should also be provided if manual initiation and control for the AFW system is needed. (See Recommendation GL-3 for the longer term resolution of this concern).

<u>RG&E Response</u>

RG&E believes that the turbine driven AFW pump is capable of providing the required AFW flow for a period of two hours independent of AC power. A test of the turbine driven pump was conducted August 10, 1979 to support that conclusion. In a phone conversation between George Wrobel of RG&E and Phil Matthews of the Bulletins and Orders Task Force on November 16, 1979 it was agreed that RG&E should submit the actual test data for NRC review, in lieu of the emergency procedures suggested in this recommendation. The test data is found in attachment 1. Included in the attachment is an evaluation which shows why our recirculation flow test was considered adequate to represent a full flow test.

Additional questions arose as a result of the November 16, 1979 conversation. The questions and responses follow:

a) Do we require safety-related air conditioning for proper functioning of the turbine driven AFW system.

Response: No. The turbine-driven pump is not located in an enclosed room, but in a large building (the intermediate building). There would be no significant ambient temperature heatup of the area as a result of the pump operation which would affect system performance. Detailed reviews of the design and layout of the Ginna AFW system have been performed by SEP Branch personnel during their evaluations of the Safe Shutdown and Pipe Break Outside Containment topics.

b) Is steam used to run the pump turbine hotter during hot shutdown than during power operation?

Response: Yes. However, the difference is not significant (~545 vs. ~515°F). The substantial margins between temperatures of the lube oil and end bearing experienced during the test vs. limiting temperature conditions for these items should more than offset this minor difference in temperature.

c) What is the relationship between pump brake horsepower vs. flow.

Response: See final figure of attachment 1.

3. <u>Recommendation GS-6</u> - The licensee should confirm flow path availability of an AFW system flow train that has been out of service to perform periodic testing or maintenance as follows:

- Procedures should be implemented to require an operator to determine that the AFW system valves are properly aligned and a second operator to independently verify that the valves are properly aligned.

- The licensee should propose Technical Specifications to assure that prior to plant startup following an extended cold shutdown, a flow test would be performed to verify the normal flow path from the primary AFW system water source to the steam generators. The flow test should be conducted with AFW system valves in their normal alignment.

<u>RG&E Response</u>

The Periodic Test (PT) and Maintenance (M) procedures concerning the AFW system have been updated since the TMI accident to ensure proper system performance following maintenance on the system. Additional steps have been added to the Periodic Test procedures to verify that the system has been realigned for operation. Verification of realignment of the system is performed by personnel other than testing personnel, the Operations personnel.

In addition new procedures have been developed and incorporated in plant operations to assure proper valve line-up. These system valve position verification procedures are performed on a regularly scheduled basis. The performance of these procedures is in addition to the valve verification steps included in the Periodic Test procedures.

Our present Technical Specifications (Section 4.8) require that each motor driven pump be tested at a flow rate of 200 gpm and that the turbine driven pump be tested at a flow rate of 400 gpm at least once a month or prior to reaching 5% power during a startup if the time since the last test exceeds one month. Specification 3.4 requires that the AFW flow paths be operable.

Our current practice to meet these technical specifications is to perform flow tests which demonstrate that the flow paths from the AFW pumps to the steam generators is operable. The main AFW system utilizes its primary water source for this test. The standby AFW system uses water from a test tank instead of its primary source (service water) for this test. Thus our current practice for the main AFWS meets the NRC recommendation and our practice for the standby AFWS is the best test that can be run given the primary water source quality. Our specifications will be changed to incorporate our present practice following extended cold shutdowns within the coming year.

4. Recommendation GS-7 - The licensee should verify that the automatic start (M) AFW system signals and associated circuitry are safety-grade. If this cannot be verified, the (M) AFW system automatic initiation system should be modified in the short-term to meet the functional requirements listed below. For the longer term, the automatic initiation signals and circuits should be upgraded to meet safety-grade requirements as indicated in Recommendation GL-5.

- The design should provide for the automatic initiation of the auxiliary feedwater system flow.
- The automatic initiation signals and circuits should be designed so that a single failure will not result in the loss of auxiliary feedwater system function.
- Testability of the initiation signals and circuits shall be a feature of the design.
- The initiation signals and circuits should be powered from the emergency buses.
- Manual capability to initiate the auxiliary feedwater system from the control room should be retained and should be implemented so that a single failure in the manual circuits will not result in the loss of system function.
- The alternating current motor-driven pumps and valves in the auxiliary feedwater system should be included in the automatic actuation (simultaneous and/or sequential) of the loads to the emergency buses.
- The automatic initiation signals and circuits shall be designed so that their failure will not result in the loss of manual capability to initiate the AFW system from the control room.

RG&E Response

There are two independent motor driven auxiliary feedwater pumps, each fed from a separate Class 1E power train. Automatic initiation circuits are designed so that no single failure will result in loss of AFW system function. These circuits are an integral part of the Safeguards Actuation System and are therefore safety grade. The power and control circuits for the AFW system conform to the recommendations in this section.

X.4.3.2 Additional Short-Term Recommendations

The following additional short-term recommendations resulted from the staff's Lessons Learned Task Force review and the Bulletins and Orders Task Force review of AFW systems at Babcock & Wilcox-designed operating plants subsequent to our review of the AFW systems designs at W- and C-E-designed operating plants. They have not been examined for specific applicability to this facility.

1. Recommendation - The licensee should provide redundant level indications and low level alarms in the control room for the AFW system primary water supply to allow the operator to anticipate the need to make up water or transfer to an alternate water supply and prevent a low pump suction pressure condition from occurring. The low level alarm setpoint should allow at least 20 minutes for operator action, assuming that the largest capacity AFW pump is operating.

RG&E Response

The existing single train condensate storage level indication provides a low level alarm which provides more than 20 minutes warning for operator action to switch to the service water supply as the AFW source. The Technical Specification condensate storage source water volume is sufficient to provide for a minimum of 37 minutes of operation for the largest capacity AFW pump, prior to requiring a switchover to Service Water as the pump suction source. The level indication and alarm circuits will be modified to provide redundancy by January 1, 1981.

2. Recommendation The licensee should perform a 72-hour endurance test on all AFW system pumps, if such a test or continuous period of operation has not been accomplished to date. Following the 72-hour pump run, the pumps should be shut down and cooled down and then restarted and run for one hour. Test acceptance criteria should include demonstrating that the pumps remain within design limits with respect to bearing/bearing oil temperatures and vibration and that pump room ambient conditions (temperature, humidity) do not exceed environmental qualification limits for safety-related equipment in the room.

RG&E Response

A 72 hour endurance test of standby and turbine driven AFW pumps will be conducted in the following manner. The standby AFW pumps primary water source is Lake Ontario which is untreated. For testing there is a 10,000 gallon supply tank with treated water. Our water inventory of treated water would not allow the testing of these pumps at full flow for 72 hours. Therefore, each standby pump will be operated on recirculation for the required period. Following the 72 hour test the pumps will be cooled down and then restarted and run for one hour. This test will be conducted within the next 6 months.

Pumping cold AFW into the steam generators makes the steam generator level control less stable than normal. Therefore, the turbine driven AFW pump test will be conducted on recirculation flow.

The turbine driven pump test must be conducted during power operation so that steam is available for turbine operation. The turbine driven pump is near the control rod drive cabinets in the intermediate building. Although a small increase in temperature and humidity in the intermediate building will not affect the ability of the AFW system to function properly, the non-safety grade control rod drive cabinets may be affected and cause an inadvertent reactor trip. A new ventilation system is being designed for this building which should prevent adverse affects upon the control rod drive cabinets. The system is scheduled to be installed in the next six months. Therefore, the test of the turbine driven pump will be conducted after the new ventilation system is installed.

The main motor driven AFW pumps cause the steam generator blowdown valves to be isolated when the pumps are started. Operation of the steam generators without blowdown for extended periods could create water chemistry problems. To maintain the blowdown valves open during operation of the main motor driven pumps would require jumping the controls for the blowdown valves. The blowdown valves are normally isolated on main motor driven pump start and high radiation alarm. For these reasons no extended endurance test is proposed for the main motor driven pumps. However, these pumps are routinely used during each startup and shutdown and since initial plant operation have accumulated total operating times in excess of 2400 hours. No test is deemed necessary to verify acceptable performance of these pumps.

3. Recommendation - The licensee should implement the following requirements as specified by Item 2.1.7.b on page A-32 of NUREG-0578:

> "Safety-grade indication of auxiliary feedwater flow to each steam generator shall be provided in the control room.

The auxiliary feedwater flow instrument channels shall be powered from the emergency buses consistent with satisfying the emergency power diversity requirements for the auxiliary feedwater system set forth in Auxiliary Systems Branch Technical Position 10-1 of the Standard Review Plan, Section 10.4.9."

RG&E Response

Refer to the RG&E response dated November 21, 1979 to the October 30, 1979 TMI Letter, Section 2.1.7.b.

4. Recommendation - Licensees with plants which require local manual realignment of valves to conduct periodic tests on one AFW system train and which have only one remaining AFW train available for operation, should propose Technical Specifications to provide that a dedicated individual who is in communication with the control room be stationed at the manual valves. Upon instruction from the control room, this operator would realign the valves in the AFW system train from the test mode to its operational alignment.

RG&E Response

The AFW system is composed of two main motor driven pumps, one turbine driven pump and two standby motor driven pumps all of which are capable of delivering the minimum required flow. Therefore, during periodic testing more than one additional flow train is available so that this recommendation does not apply to R. E. Ginna.

X.4.3.3 Long-Term

Long Term recommendations for improving the system are as follows:

1. Recommendation - GL-3. At least one AFW system pump and its associated flow path and essential instrumentation should automatically initiate AFW system flow and be capable of being operated independently of any alternating current power source for at least 2 hours. Conversion of direct current power to alternating current is acceptable.

RG&E Response

At present, the only dependence on AC power of the turbine-driven auxiliary feedwater system is for service water to the turbine lube oil cooler and pump end bearing. Since the service water pumps are AC powered, service water would be lost to the these items when AC power is lost. A test of the turbine driven pump with no service water cooling has adequately demonstrated that this pump can be operated for two hours without AC power (see response X.4.3.1.2). Nevertheless, all AC power dependence will be removed by making a piping change which will recirculate a small amount (10-15 gpm) of auxiliary feedwater from the pump discharge (or from a pump intermediate stage), to the lube oil cooler and end bearing. With this piping change, the turbine-driven auxiliary feedwater system can be operated independent of any AC power sources. This modification will be completed by January 1, 1981.

2. Recommendation - The licensee should evaluate the water source capabilities (AC powered service water pumps, condensate transfer pumps and the limited inventory of condensate storage tank water gravity feed to the turbine pump suction to assure that there is a water source sufficient to supply the required AFW flow for 2 hours independent of any AC power source.

RG&E Response

Our review of the water source capabilities to provide AFW flow for 2 hours independent of any AC power source is not yet complete. The results of our review and any technical specification changes, if required, will be submitted by April 1, 1980.

3. Recommendation - GL-5. The licensee should upgrade the AFW system automatic initiation signals and circuits to meet safety-grade requirements.

RG&E Response

The existing automatic initiation signals and circuits meet safety-grade requirements.

4. There is no provision for either the main or standby AFWSs to automatically terminate flow to a depressurized steam generator and automatically provide flow to the intact steam generator. This is accomplished by the control room operator. The lack of this automatic capability will be further evaluated as part of the Systematic Evaluation Program.

RG&E Response

No response required.

5. The main and standby AFWSs will be reevaluated for internal and external missiles, seismic design requirements, and flood and tornado protection as part of the Systematic Evaluation Program.

RG&E Response

No response required.

Rochester Gas and Electric Corporation

Inter-Office Correspondence

August 15, 1979

SUBJECT: Bearing Cooling Test/Turbine Driven Auxiliary FW Pump Ginna Station

TO: J. C. Hutton
R. C. Mecredy

On August 10, an abbreviated test was conducted on the Turbine Driven Auxiliary FW Pump. The purpose of the test was to evaluate: (1) the operability of the steam turbine without the availability of service water to cool the bearing lube oil, and (2) the operability of the pump without the availability of service water to cool the end bearing jacket.

The turbine was warmed up by opening the manual isolation valve at the turbine inlet. With the auxiliary feedwater line discharge valves open and the steam lines' motor-operated valves leaking, the turbine operated in a "windmill" condition. Initial conditions were recorded as follows:

Pump End Bearing Temp.	- 90°F
Lube Oil Temp.:	
Cooler Inlet	- 88°F
Cooler Oulet	- 83°F
Service Water Temp.:	
Cooler Inlet	- 80°F
Cooler Outlet	- 79°F

The test began when service water to the pump end bearing and to the lube oil cooler was shut off. Bearing temperatures were recorded at one (1) minute intervals for nine (9) minutes (from T1 to T9) as shown on data sheet 2. The time interval was increased to two (2) minutes for the next ten data recordings. At T20, the pump discharge valves were closed, and the pump recirculation valve was opened. When the steam lines' motor-operated valves were opened, the turbine ran at near rated speed. At T44, a change in data takers was made. At T50, data recording was halted because of the unusual scatter of the data. The probe of the contact pyrometer was changed, and data recording resumed at T73. The data scatter was

was now significantly reduced, and it was felt that the recorded temperatures were now reasonable. Since the operators had reduced power by 1/2%, it was decided to run the test only as long a time as required to achieve stable bearing temperatures. At T95, it was decided that a condition of stable bearing temperatures had been achieved.

In order to assess the response to cooling of the lube oil system, service water was restored. It can be seen that the lube oil is cooled 17°F in seven minutes when service water is restored. Thus, the lube oil system response is relatively rapid.

From the pump operating manual, it should be pointed out that the minimum end bearing lube oil temperature is specified as 100°F. The recommended end bearing lube oil temperature is >120°F, but <150°F.

From the turbine operating manual, service water cooling is not required until bearing lube oil temperature exceeds 120°F. Normal lube oil operating temperature is 140°F, and maximum allowable lube oil temperature is 180°F.

It may be seen from initial data recordings that the lube oil temperature of the turbine exhaust end bearing is approximately 10°F higher than that of the steam end. Accordingly, lube oil temperatures in and out of the exhaust end bearing were recorded for T73 and thereafter.

Since the principal source of heat imparted to the turbine bearings is from the motive steam, it is significant to assess the change in heat load to the turbine when increasing auxiliary feedwater flow from maximum recirculation (~95 GPM) to minimum required safeguards auxiliary feedwater flow (200 GPM). Based on the turbine steam rate of ~30 lb/hr/hp (GAI BOM), the required energy input to the turbine at 95 GPM is ~13.4 x 10^6 BTU/HR and at 200 GPM is ~14.3 x 10^6 BTU/HR. This represents only a 6.7% increase in heat input to the turbine. The relatively small increase of required input energy is evidenced by the flat slope of the pump BHP curve (attached). Therefore, it can be concluded that although the test was conducted at a pump flow of ~100 GPM, no drastic bearing temperature change can be anticipated at 200 GPM.

Gene Voci (signature)

Gene Voci
Mechanical Engineer

EKV:mkv
Attachments

xc: R. E. Smith
D. Gent
G. Larizza
S. Beluke
G. Wrobel

PT 16.2 DATA SHEET # 2-1

		PUMP END BEARING TEMP. – °F	LUBE OIL TEMP. EXHAUST END BEARING OUTLET – °F	LUBE OIL TEMP. STEAM END BEARING OUTLET – °F	SERVICE WATER TEMP. COOLER INLET – °F
Δ1 MINUTE	T1 →	87	92	85	N/A
	T2	87	96	85	
	T3	87	95	86	
	T4	87	95	87	
	T5	88	102	86	
	T6	87	98	88	
	T7	88	101	87	
	T8	89	101	88	
Δ2 MINUTES	T9 →	90	99	88	
	T10	90	100	86	
	T11	88	100	87	
	T12	85	97	85	
	T13	86	102	87	
	T14	93	100	89	
	T15	84	97	85	
	T16	85	98	89 ~~98~~ [initials]	
	T17	83	100	86	
	T18	87	99	91	
	T19	85	101	88	
Δ1 MINUTE	T20 →	87	97	88	4450 RPM
	T21	87	101	94	
	T22	88	97	91	

P.T. 16.2

~~D~~ATA SHEET # 2 2 Cont. -2

	PUMP END BEARING TEMP. - °F	LUBE OIL TEMP. EXHAUST END BEARING OUTLET - °F	LUBE OIL TEMP. STEAM END BEARING OUTLET - °F	RPM ~~SERVICE WATER TEMP. COOLER INLET - °F~~
T1 23	86	100	91	
T2 24	90	103	92	4450 RPM
T3 25	91	105	93	> 4400
T4 26	92	101	89	4400
T5 27	94	106	89	4400
T6 28	91	102	94	> 4400
T7 29	92	106	95	4400
T8 30	92	106	99	
T9 31	90	107	91	
T10 32	92	107	98	> 4400
T11 33	100	109	103	> 4400
T12 34	96	108	103	
T13 35	95	109	103	
T14 36	93	109	98	
T15 37	96	106	96	> 4400
T16 38	101	110	105	
T17 39	102	111	103	
T18 40	96	110	99	
T19 41	100	110	106	
T20 42	107	111	~~1~~99 ~~96~~	
T21 43	100	111	106	
T22 44	105	96	100	

PT 16.2

DATA SHEET #2 -3

	PUMP END BEARING TEMP. - °F	LUBE OIL TEMP. EXHUAST END BEARING OUTLET - °F	LUBE OIL TEMP. STEAM END BEARING OUTLET - °F	~~SERVICE WATER TEMP. COOLER INLET - °F~~
T~~1~~45	98	105	91	
T~~2~~46	102	103	92	
T~~3~~47	99	105	108	
T~~4~~48	96	103	92	
T~~5~~49	99	104	94	
T~~6~~50		LUBE OIL TEMP. EXH. END OUTLET TEMP. - °F	LUBE OIL TEMP. STEAM END INLET TEMP. - °F	
T13 T~~7 51~~ 73	114	117	112	CHANGED PROBES
T~~8 52~~ 74	116	117	112	
T~~9 53~~ 75	115	118	113	
T~~10 54~~ 76	115	118	111	
T~~11 55~~ 77	116	118	113	
T~~12 56~~ 78	117	118	113	
T~~13 57~~ 79	115	115	112	
T~~14 58~~ 80	116	116	115	
T~~15 59~~ 81	116	120	115	
T~~16 60~~ 82	115	119	115	
T~~17 61~~ 83	116	120	117	
T~~18 62~~ 84	116	119	118	
T~~19 63~~ 85	117	119	118	
T~~20 64~~ 86	119	120	118	
T~~21 65~~ 87	118	118	118	
T~~22 66~~ 88	117	119	117	

PT 16.2

DATA SHEET # 2-4

	PUMP END BEARING TEMP. - °F	LUBE OIL TEMP. EXHAUST END BEARING INLET - °F	LUBE OIL TEMP. STEAM END BEARING OUTLET - °F	~~SERVICE WATER TEMP. COOLER INLET - °F~~
T~~1~~89	118	119	116	
T~~2~~90	118	119	118	
T~~3~~91	119	120	118	
T~~4~~92	119	120	121	
T~~5~~93	118	119	119	
T~~6~~94	118	122	120	
T~~7~~95	117	119	121	
T~~8~~96				
T~~9~~97				
T~~10~~98				
T~~11~~99				
T~~12~~100	120	121	113	COOLING WATER RESTORED
T~~13~~101	119	119	109	
T~~14~~102	120	120	107	
T~~15~~103	121	121	104	
T~~16~~104	120	122	105	
T~~17~~105				
T~~18~~106				
T~~19~~107	121	119	102	
T20				
T21				
T22				

GILBERT ASSOCIATES, INC.

BILL OF MATERIALS

File

BM SYMBOL BROOKWOOD-

SHEET NO. 11

LOCATION: Pittsburgh, Pa.

CLIENT: Westinghouse Atomic Power Division
(Rochester Gas & Electric Corporation)

FOR: Feed Water System
Robert Emmett Ginna Nuclear Power Station - Unit No. 1

GAI W. O. 4155

CLIENT W. O. RH-33000

ITEM NO.	QUANTITY	DESCRIPTION OF MATERIAL		ISSUE	ORDE
RC-6	1	STEAM DRIVEN Auxiliary Feedwater Pump, Worthington Corp. Model 3WTL-87-seven stage horizontally split, centrifugal pump. The pump shall be furnished with a minimum flow orifice. A curve to be furnished showing pump characteristics at various steam inlet pressures and steam consumption.		1	2150
		Design Data			
		Capacity	400 gpm		
		Total dynamic head	3,000 ft		
		Feedwater temperature	65-97°F		
		NPSH required	20.2 ft		
		Pump suction	Flooded		
		Steam pressure, operating	680-1085 psig		
		Steam temperature, operating	500-556°F		
		Steam conditions	1/4% moisture		
		Turbine exhaust pressure	10 psig		
		Speed	4575 rpm		
		Efficiency	67.5%		
		BHP	449		
		Minimum flow	95 gpm		
		Cooling water required	3 gpm		
		Construction			
		Casing	5% chrome steel		
		Shaft	13% chrome steel		

(Continued Sheet 12)

ISSUE NO. (1)
DATE 11-15-66
EDITOR SP
ENGINEER RSY

GAI-

LBERT ASSOCIATES, INC.

BILL OF MATERIALS

BM SYMBOL BROOKWOOD-RC
SHEET NO. 12

LOCATION: Pittsburgh, Pa.

CLIENT: Westinghouse Atomic Power Division (Rochester Gas & Electric Corporation)
FOR: Feed Water System, Robert Emmett Ginna Nuclear Power Station - Unit No. 1

GAI W. O. 4155
CLIENT W. O. RH-33000

QUANTITY	DESCRIPTION OF MATERIAL		ISSUE	ORDER NO.
	Impellers	13% chrome steel	1	216026
	Wearing rings	13% chrome steel		
	Shaft sleeves	13% chrome steel		
	Diffusers	5% chrome steel		
	Bearings	Oil lubricated ball bearings		
	Discharge flange	3" - 1500# ASA		
	Suction flange	4" - 600# ASA		

Pump shall be furnished with the following:

1 — Steam Turbine Drive, Worthington Type S, single stage, and shall require steam at 29.7 lbs/hp/hr at 680 psi, 10 psi exhaust and 500°F. Turbine shall be rated 450 hp at 4575 rpm. The turbine shall be suitable for quick starting.

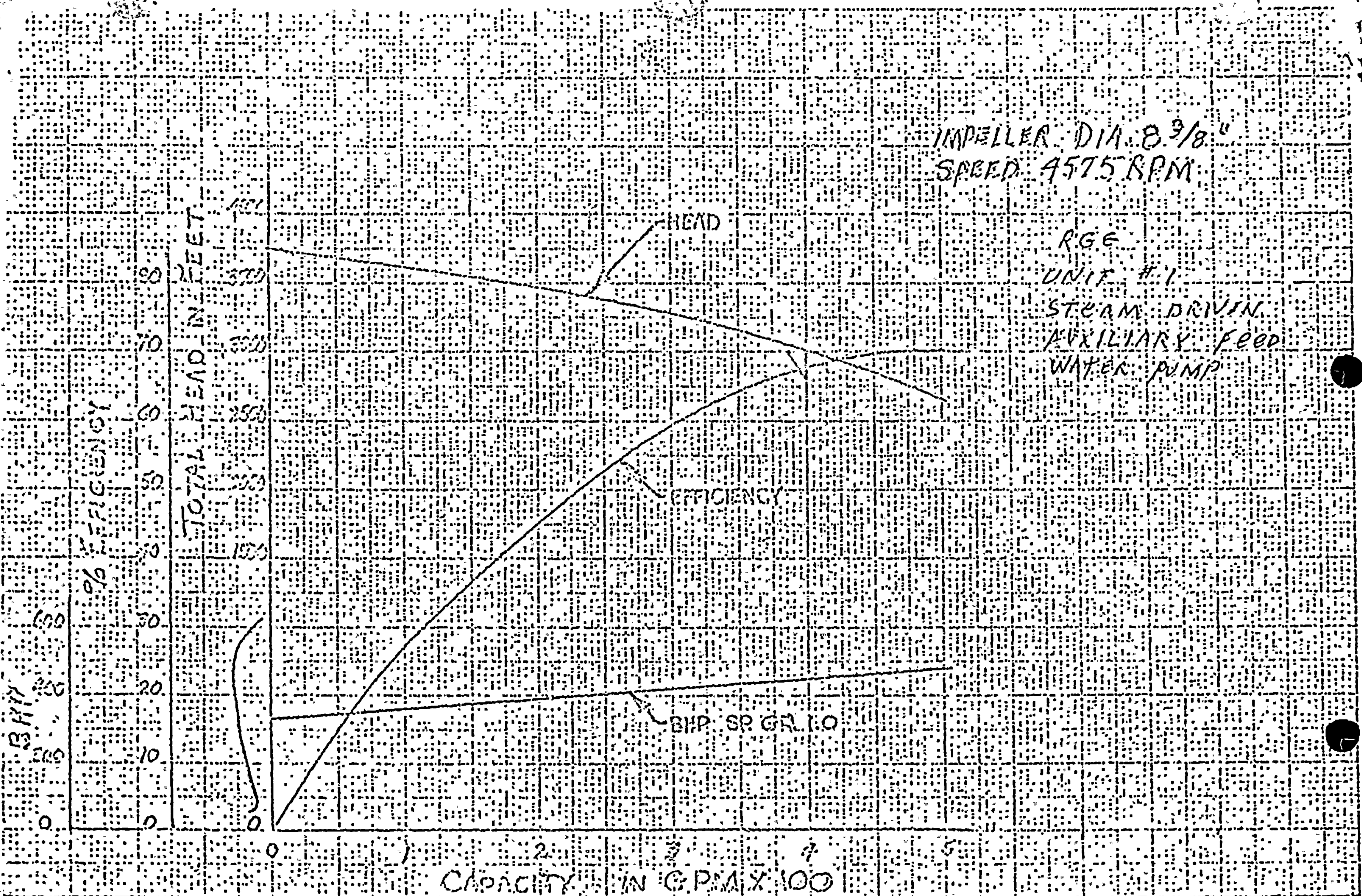
Turbine shall be furnished with a Woodward oil relay direct acting constant speed governor, governor valve, integral steam strainer basket, insulation and jacket for the casing, tachometer, mounted half coupling, two (2) 4-1/2" steam pressure gauges, and trip and throttle valve limit switch.

Turbine Construction:

Casing	Carbon steel
Shaft	Alloy steel
Bucket wheels	Forged steel
Blades	Stainless steel

(Continued Sheet 13)

DATE 2-25-66



HOW TESTED:	CAPACITY 400 GPM	DRIVER 200 HP [illegible]	SPEED 3556 - 3512	DRIVE DIRECT		
TEST CURVE	WORTHINGTON CORPORATION		NEW YORK		6-41-9962 ORDER NO.	TEST NO.
WM 4/2/63 DATE	3 SIZE	WTL-8-7 TYPE	STYLE	1614756 MACHINE	4575	B-1 CURVE NO. / E-15583-4 CURVE NO.