DOCKETED

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AECOM

Mandalay Fire Protection System Study

31380-P037

31380-P037-FP-001

Analysis of Existing FPS to Support Proposed Puente Power Project

PREPARED FOR

AECOM
6200 S. Quebec Street
Greenwood Village, CO 80111

Revision: 2 Status: Final DRAFT

STUDY REVISION PAGE

Project Name:	Mandalay Fire Protection Study	Discipline:	Fire Protection
Client:	NRG	Project No:	31380–P037

Revision Signatures

Frank Tagge	05-23-16		
Prepared by	Date	Approved by (SDE) Denice M Gonzales	Date 05-23-16
Checked by	Date	Approved by (PEM)	Issue Date

Status	Rev. No.	Date	Prepared By	Pages	Description of Changes
Final	0	05/23/16	FWTagge	All	Incorporate client comments
For Use	1	06/14/16	DMG	All	Remove Confidential and Proprietary footer note, add Appendix D
Final Draft	2	07/19/16	FWTagge	All	Released as Final Draft

Table of Contents

Executive Summary

NRG proposes to install a new combustion turbine (P3) and replace existing Units 1 and 2. The California Building and Fire Codes, and NFPA® 850 - Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations, were reviewed to determine the required fire flow for P3. This review indicated that the minimum acceptable fire flow is 500 gpm. Based on the existing facility description and criteria, and the rated capacity of the pumps, a fire flow of 1,000 gpm is used in the hydraulic analysis; this exceeds the minimum recommended fire flow.

The existing fire water loop will need to be extended to provide fire suppression capabilities for P3. The existing fire water loop and the proposed / postulated extension have been hydraulically modeled using the HASS (Hydraulic Analysis of Sprinkler Systems) software package. Data provided by NRG was used to determine the existing fire water loop configuration in the area of P3, as well as the proposed extension; additionally fire pump flow test data, also provided by NRG, was used in modeling the pump performance.

Three hydrants are proposed to be located on the P3 fire water loop extension. All three hydrants were set to flow in the hydraulic model, for a total of 1,000 gpm (the rated capacity of one existing pump). The residual pressure in the water tank was set to 0 psi, simulating the lowest water level possible in the tank.

Under the stated conditions, the pressure available at each flowing hydrant exceeded the criteria established for the existing facility (60 psi). Additionally, the pressure at the flowing hydrants exceeds 100 psi, the typically recommended minimum pressure for hose flows. Finally, under the stated conditions, the suction pressure at the pump was determined to be -2.1 psi; exceeding the minimum -3.0 psi suction pressure allowed by NFPA 20.

The performance of the proposed P3 fire water extension loop, as postulated and modeled, exceeds the minimum flow and pressure recommendations found in the reviewed documents; thus, is determined to be acceptable.

1.0 Background

NRG is seeking to add a new simple cycle combustion turbine (CT) as Puente Power Project (P3) at the Mandalay Generating Station. This new P3 will replace existing Units 1 and 2 which will ultimately be taken out of service and demolished. As part of this project, NRG proposed to extend the existing fire water loop around P3 to provide fire suppression capabilities via yard hydrants as required. AECOM/URS was requested to analyze the existing fire water system of the capabilities of meeting the flow, pressure and capacity required for the new Puente unit. The analysis was also requested to include review of applicable California and NFPA codes.

1.1. Existing System Criteria

The existing fire water system consists of an 8" diameter asbestos cement lined ductile iron fed by two (2) 1,000 GPM fire water pumps rated at 120 psig. The pumps are sized to supply a minimum pressure of 60 psi at any hydrant on the existing facility when four (4) hydrants are in operation. The pumps are installed in parallel, and are presumed to each be 100% capacity pumps for the existing plant.

The two fire water pumps take suction from a 445,000 gallon service water tank, of which approximately 96,000 gallons are reserved for fire water use. The tank is 40 ft. in diameter, by 48 ft. high (nominal). The tank is automatically supplied by city water through a level control valve and level controller on the tank. The positive fire water reserve of 96,000 gallons equates to a depth above suction pipe of approximately 10 ft., or approximately 4.4 psi of suction head.

1.2. Objectives

The objectives of this study are to:

- Determine the required or recommended fire flow for the P3 unit
- Determine if the existing fire water main can be extended to provide coverage to the new P3 unit and provide adequate flow and pressure at new hydrants using the existing pumps
- Review code requirements and determine that applicable codes are met

2.0 Codes and Standards

The following Codes contain mandatory requirements:

- California Building Code (CBC), 2013 edition
- California Fire Code (CFC), 2013 edition

The following Recommended Practice is widely recognized and used in the industry as guidance and good engineering practice:

- National Fire Protection Association (NFPA®) 850 – Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations (NFPA® 850), 2015 edition

3.0 Discussion of Fire Water Requirements

3.1. Basis of analysis

- The referenced editions of the CBC and CFC are the currently adopted editions and are thus the governing documents. As such any pertinent requirements found in these Codes are mandatory and must be met.
- NFPA® 850 is not listed as a referenced standard in either the CBC or CFC NFPA® 850 is a recommended practice, and will be considered for "good engineering practice" and guidance but is not mandatory. Since NFPA® 850 is not referenced in the CBC or CFC, the most current edition of this recommended practice has been utilized.
- There are no local codes or regulations, and no underwriter requirements, which must be met.
- Only fires external to the CT are considered. Suppression internal to the CT (e.g., at bearing housings, or hydraulic and lubricating oil reservoirs) is a self-contained fine water mist system provided by the CT vendor (confirmed by NRG), does not require an external source of water, and is not considered in this study.
- The auxiliary electrical / switchgear enclosure associated and provided with the CT is provided with necessary fire protection means (e.g., detection and extinguishers) by the CT vendor. This enclosure is considered part of the CT equipment package.
- There are no new buildings associated with P3. A new control room is being installed in an existing office space within the existing shop / warehouse. It is assumed that the existing shop / warehouse and office space are appropriately and adequately protected.
- The unit transformer is mineral oil filled and contains in excess of 5,000 gallons of mineral oil.
- The study is based on the best available information at the time, and does not include field verification by AECOM fire protection engineer.
- This study and supporting calculations have been prepared by a California licensed fire protection engineer, but are "preliminary" in nature and not to be used for construction purposes.
- This study is limited to the suppression requirements associated with the new P3 unit. There may be other fire protection related (e.g., fire detection and alarm) requirements which are not addressed in this study.
- It is assumed that the existing fire water loop and pumps comply with the applicable Codes at the time of installation and have been properly inspected, tested and maintained in accordance with applicable codes and standards (e.g., the California Edition of NFPA® 25 – Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems).

3.2. California Building Code

The CBC was reviewed for requirements pertaining to electric generation plants / power plants and references to NFPA® 850 with the following results and conclusions:

- NFPA® 850 is not adopted or referenced by the CBC.

- "Electric generation plants" are listed under Section 306.2 "Moderate-hazard factory industrial, Group F-1". Buildings associated with electric generation plants, such as steam turbine buildings, are thus required to meet Group F-1 requirements.
- Other than the reference to "electric generation plants" as a Group F-1 occupancy, the CBC does not contain any direct references to this type of facility. Group F-1 occupancies with fire areas (as defined by the CBC) greater than 12,000 ft^2 require automatic fire sprinkler systems per CBC Section 903.2.4 (the CBC takes this requirement from the CFC). As noted, there are no new buildings associated with the P3 unit; therefore this requirement does not apply.

  CBC definition of a fire area: *"FIRE AREA. The aggregate floor area enclosed and bounded by fire walls, fire barriers, exterior walls or horizontal assemblies of a building. Areas of the building not provided with surrounding walls shall be included in the fire area if such areas are included within the horizontal projection of the roof or floor next above."*

- While enclosed, the CT is a piece of equipment and is provided with self-contained fire protection system(s) by the manufacturer. These integral on-board systems are adequate for protection of the equipment. Additionally, the footprint of the CT appears to be approximately 9,000 ft^2; therefore, even if considered a building the CT would not require an automatic sprinkler system. The auxiliary electrical / switchgear enclosure provided with the CT is also less than 1,000 ft^2 in area and does not require an automatic sprinkler to be installed.
- The new control room in the existing shop / warehouse building is being installed in an area already used as office space. The existing office space into which the new control room is being installed would be considered an ancillary or auxiliary use in the shop / warehouse if less than 10% of the shop / warehouse floor area. A complete review of the existing shop / warehouse is outside the scope of this document; however, this building is assumed to be appropriately and adequately protected. Both the control room and the office space are considered Group B occupancies; thus there is no change of occupancy. Finally, the CBC has no requirements for sprinkler protection of a Group B occupancy.
- It is concluded that there are no pertinent requirements in the CBC which mandate the amount of fire water flow for the P3 unit.

3.3. California Fire Code

NOTE: The CBC and CFC are companion documents, and incorporate identical requirements for overlapping subject areas; e.g., the CBC defines occupancies, and the CFC incorporates those definitions. Similarly, the CFC establishes fire suppression requirements, and the CBC incorporates those requirements. The CFC was reviewed for additional requirements pertaining to electric generation plants / power plants and references to NFPA 850 with the following results and conclusions:

- NFPA 850 is not adopted or referenced by the CFC.
- Electric generation plants are defined as Group F-1 Occupancies, per the CBC.
- Fire suppression requirements incorporated in the CBC (and noted above) are defined in the CFC. The CFC does not contain any additional requirements for Group F-1 occupancies.

- Appendix B of the CFC, Fire-Flow Requirements for Buildings, is used to determine the fire-flow, or flow rate of a water supply, required for fire fighting. The appendix specifically refers to "buildings" and the determination of fire flow is dependent on building size and construction. Since there are no new buildings associated with the P3 unit, this appendix does not apply.
- As with the CBC, it is concluded that there are no pertinent requirements in the CBC which mandate the amount of fire water flow for the P3 unit.

3.4. NFPA® 850 – Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Stations

Full application of NFPA 850, applied to a new facility, requires the development of a design basis document (DBD) evaluating plant-specific hazards and conditions, and determining plant-specific fire protection and prevention guidelines for the hazards identified. The DBD development process includes review of Codes, Standards, and Regulations, industry references, other design documents and stakeholder inputs. Full application of NFPA 850 for P3 is outside the scope of this study. This study is limited to review of the applicable Codes (CBC and CFC) and standards (NFPA® 850) and applicable documents provided by NRG; no other regulations or specific industry standards have been reviewed.

For the purposes of this study, the following new hazards are identified and considered:

- Combustion turbine
- Transformers

Review of NFPA® 850 is limited to those sections pertinent to fire suppression recommendations for the CT and the transformers.

Water Supply

NFPA® 850 recommendations for the fire water supply are as follows:

> *"6.2.1* The water supply for the permanent fire protection installation should be based on providing a 2-hour supply for all of the following:*
>
> *(1) Either of the following, whichever is greater:*
>
> *(a) The largest fixed fire suppression system demand*
>
> *(b) Any fixed fire suppression system demands that could reasonably be expected to operate simultaneously during a single event [e.g., turbine underfloor protection in conjunction with other fire protection system(s) in the turbine area, coal conveyor protection in conjunction with protection for related coal handling structures during a conveyor fire, adjacent transformers not adequately separated according to 5.1.4.]*
>
> *(2) The hose stream demand of not less than 500 gpm (1893 L/min)*
>
> *(3) Incidental water usage for non–fire protection purposes"*

For the P3 unit, there are no proposed fixed fire suppression systems, transformers are adequately separated, and no fixed system requirements have been identified. Thus, the minimum recommended water supply, in accordance with NFPA® 850, is 500 gpm for 2 hours, or a minimum supply of 60,000 gallons. The existing fire water reserve of 96,000 gallons provides 3.2 hours capacity at 500 gpm.

Combustion Turbine

Packaged CT units are typically "self-contained" and include fire suppression system(s) appropriate for the internal hazards of the CT. These systems may include fine water mist systems, gaseous (clean agent or CO2) systems, or other systems. NRG has confirmed that the CT is equipped with a self-contained fine water mist system.

The auxiliary electrical / switchgear enclosure is considered part of the CT equipment package. These enclosures are typically provided with automatic detection and manual fire extinguishers appropriate for the electrical hazard; automatic sprinkler systems are not required or provided. It is beyond the scope of this study to review this enclosure in detail.

External hazards include exposure from other equipment or buildings, and fuel or oil piping failures. Exposure hazards are primarily controlled by appropriate plant layout and separation; fuel or oil piping hazards are largely controlled by appropriate design of the piping systems which may include welded joints, proper pipe support, guarded (pipe-within-pipe) piping, etc. It is outside the scope of this study to evaluate these means of protection.

NFPA® 850 has numerous recommendations for internal fire suppression systems of CTs, as previously mentioned. No specific recommendations pertaining to fire flow beyond that discussed under Water Supply above were found.

Transformers

NFPA® 850 recommendations for outdoor oil-filled transformers are dependent on a number of factors, including separation of the transformer from other equipment and buildings, quantity and type of oil, and containment of oil spills. Recommendations are provided for transformer oil capacities less than 500 gallons, more than 500 gallons but less than 5,000 gallons, and more than 5,000 gallons. This study considers the most conservative, and considers only the recommendations for oil capacity in excess of 5,000 gallons.

NFPA® 850, Section 5.1.4.1 notes the following for transformers:

> *"Outdoor oil-insulated transformers should be separated from adjacent structures and from each other by firewalls, spatial separation, or other approved means for the purpose of limiting the damage and potential spread of fire from a transformer failure."*

Separation criteria and guidance is provided in Table 5.1.4.3 of NFPA® 850; for transformers with oil capacity in excess of 5,000 gallons the recommended minimum separation, without firewalls, to buildings is 50 ft. When firewalls (2-hour-rated) are present, the firewalls should extend at least 1 ft. above the top of the transformer casing and oil conservator tank, and least the width of the containment basin. Additionally, the separation distance to the building is then measured "line of sight" from the oil-containing portions of the transformer to the firewall to the building. NRG has confirmed that firewalls will be used for separation of the transformers and equipment.

Oil-filled transformers not meeting the separation or fire barrier recommendations of Section 5.1.4 should be protected with automatic water spray or foam-water spray systems. However, based on information provided by NRG, the transformers are appropriately and adequately separated from each other and from the CT and therefore a fire suppression system is not required or provided.

3.5. Recommended Fire Water Supply

Based on the review of the CBC, CFC and NFPA® 850, the minimum recommended fire water supply for the P3 unit is 500 gpm, for 2 hours, or 60,000 gallons.

The existing pumps are rated at 1,000 gpm (at 120 psi). The existing water tank provides a positive reserve of 96,000 gallons for fire water, or 1.6 hours at 1,000 gpm. Considering the entire tank capacity (445,000 gallons), the tank contains approximately 7.4 hours capacity, at 1,000 gpm..

Considering the minimum recommended fire water flow of 500 gpm, the positive reserve provides approximately 3.2 hours of supply; nearly 15 hours of supply are available in the full tank. The tank provides ample capacity for the system and exceeds the minimum recommendations of NFPA® 850.

4.0 Analysis of Fire Water System

4.1. Methodology

The existing and extended fire water loop was hydraulically modeled and analyzed using the HASS (Hydraulic Analysis of Sprinkler Systems) software, an industry recognized software package used for fire protection system design. This software package performs hydraulic calculations using the Hazen-Williams equation, as required by NFPA® 24 Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

Input data for the model is summarized in Appendix A, which also includes drawings provided by NRG. Based on a bill of material provided by NRG for the original system, all piping has been modeled as asbestos cement lined ductile iron pipe. Fittings and pipe lengths are based on the drawings provided; pipe lengths have been scaled. Pipe lengths for the existing system were compared to lengths calculated from pipe centerline coordinates and found to be within a few feet in all cases checked – variances are so small that there is no noticeable difference in friction loss. A more precise analysis is not required for this analysis.

The extended loop was based on "Figure 2.7-9", as provided and annotated by NRG, with dimensions again scaled.

The existing loop on all drawings in Appendix A are marked in a heavy green line. The extended loop is indicated with a heavy blue line. Hydraulic reference / node points, corresponding to pipe end point in the HASS program, are indicated by red outlined boxes, with yellow fill, and an alphanumeric designator in the box.

Three hydrants have been shown on the proposed extended loop. All three hydrants were utilized in the calculations, providing a total flow of 1,000 gpm – this matches the existing system criteria in which 60 psi is maintained at each of four hydrants flowing 250 gpm. Two hydrants (HYD1 and HYD2) were set to flow 250 gpm each, while HYD3, the most remote hydrant, is flowing 500 gpm. If a minimum pressure of 60 psi is maintained at each flowing hydrant under the specified conditions, the system meets the same criteria as the existing system does. Most commonly used hose nozzles or monitor nozzles require 100 psi at the nozzle to provide an effective water stream for fire fighting purposes. In order to provide ample pressure for hose lines or monitors (should any be installed or used) a minimum pressure of 100 psi at the hydrant should be provided.

While the pumps are rated at 1,000 gpm at 120 psi, actual test data is available and was provided by NRG. The actual pump test data was input to the HASS program and used in the calculations.

The positive reserve in the water tank provides approximately 10 ft. of head at the suction connection, or approximately 4.4 psi. In accordance with NFPA® 20 Standard for the Installation of Stationary Pumps for Fire Protection the pressure at the suction flange of the fire pump is allowed to drop to -3.0 psi. For the purposes of the calculation, a 0 psi residual pressure at the tank (indicating the water level has dropped to the tank outlet) was used to determine if the pump suction pressure remains above -3.0 psi at the minimum water level that could be experienced.

4.2. Summary Results

Under the conditions just described, the minimum pressure at any of the 3 flowing hydrants is approximately 116 psi (HYD3, flowing 500 gpm). Additionally, the pump suction pressure (at Node P1S-S) was determined to be -2.1 psi. Since the available pressure at all flowing hydrants associated with the P3 unit exceeds 100 psi, and the pump suction pressure is greater than -3.0 psi even with a 0.0 psi residual pressure at the tank, the proposed fire water loop extension is acceptable.

5.0 Conclusions and Recommendation

The system meets or exceeds the minimum recommendations of NPFA® 850 for the minimum hose flow of 500 gpm. At a flow rate of 500 gpm, a minimum of 3.2 hours of fire flow are provided in the service water tank. At the modeled flow of 1,000 gpm, the minimum reserve of 96,000 gallons still provides more than 1.5 hours of fire flow.

The minimum pressure at a flowing hydrant, with three hydrants flowing a total of 1,000 gpm, is approximately 116 psi, well in excess of the recommended 100 psi at a hose or monitor nozzle.

The proposed P3 unit fire water loop extension as postulated and modeled for this study provides acceptable flow and pressure at the hydrants for P3.

If the postulated and modeled configuration changes significantly during detailed design the conclusions of this study may no longer be valid.

6.0 Appendices

A. Hydraulic model input data
   1. Final HASS Input Data Table
   2. Redlined Figure 2.7-9 (Firewater Loop)
   3. Redlined 550653-7 (Service Water Tanks & Pumps)
   4. Redlined 550013-4 (Yard Fire Protection System)
   5. Redlined 550015-8 (Utilities warehouse & Transformer Area)
   6. Redlined 550016-14 (Utilities West of Main Structure)

B. Hydraulic Calculation Printout

C. Client System and Equipment Data
   1. Service Water system description
   2. Fire Protection System Description
   3. Fire Pump – Pump curve

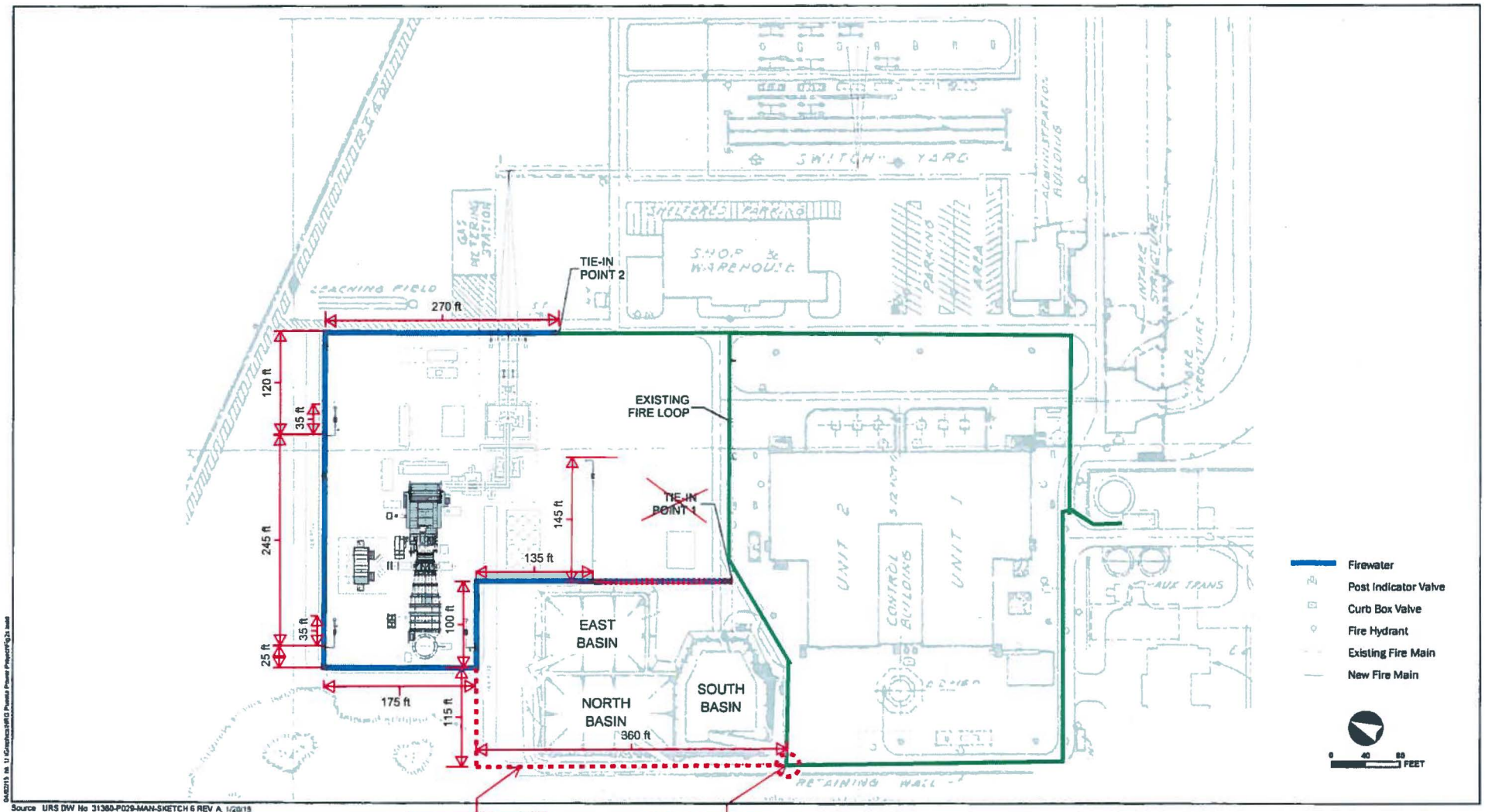
D. Fire Pump Test Results dated 6-2-15

APPENDIX A – Hydraulic Model Input Data

NRG PUENTE POWER PROJECT HYDRAULIC INPUT DATA

EXISTING LOOP

END NODE TAGS		LENGTH	FTGS	DIA	PIPE TAG	SOURCE OF DATA	NOTES
1ST	2ND						
TANK	S-MAN	40.1	G2ET	10	1	550653	assume 8 ft vertical change
S-MAN	PMP1S-S (P1S-S)	15.4	T3EG	8	2	550653	assume 8 ft vertical change
PMP1S-D (P1S-D)	A1	30.6	3ECG	6	4	550653	assume 8 ft vertical change
A1	A	19.2		8	4A	550653	
A	B	54	TG	8	5	550016	2 - 45's = 1 T
B	C-TP1	643	2ET2G	8	6	550016	
C-TP1	D	537	TE2G	8	7	550016 550015	2 - 45's = 1 T
D	B	633	TE2G	8	8	550015	
D	J-TP2	210	T2G	8	9	550015	
EXTENDED LOOP							
J-TP2	H-HYD	391	EG	8	10	550013 Fig 2.7-9	
H-HYD	HYD3	40	EGT	6	11	Fig 2.7-9	
H-HYD	G-HYD	245	G	8	12	550013 Fig 2.7-9	
G-HYD	HYD2	40	EGT	6	13	Fig 2.7-9	
G-HYD	E	201	EG	8	14	550013 Fig 2.7-9	
E	F-HYD	379	T2EG	8	15	550013 Fig 2.7-9	
F-HYD	HYD1	40	EGT	6	16	Fig 2.7-9	
E	C-TP1	475	ET2G	8	17	550013 Fig 2.7-9	



Source: URS DW No 31360-P029-MAN-SKETCH 6 REV A 1/20/15

Fire Loop Alternative Route

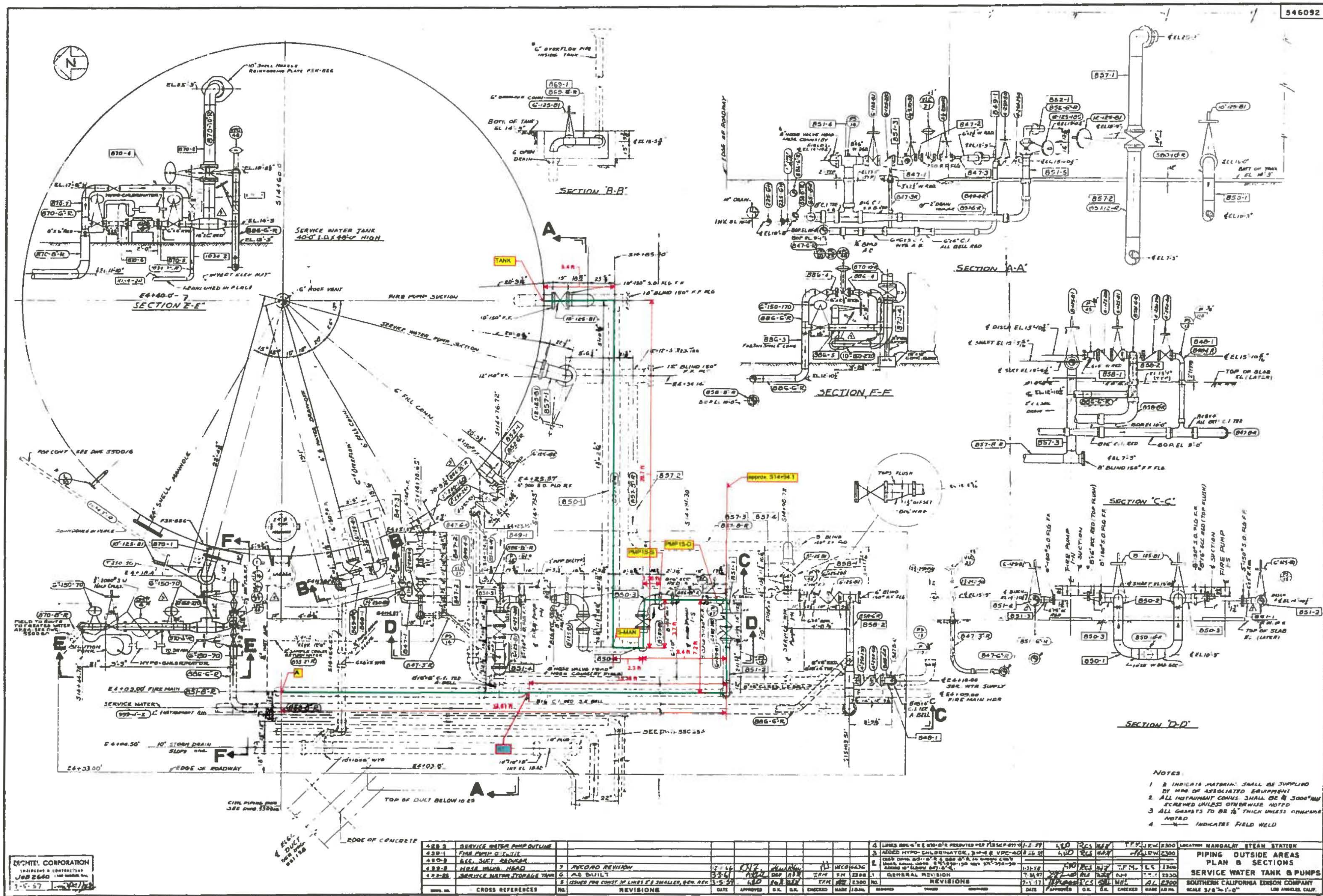
Tie-In Point 1 (Alt.)

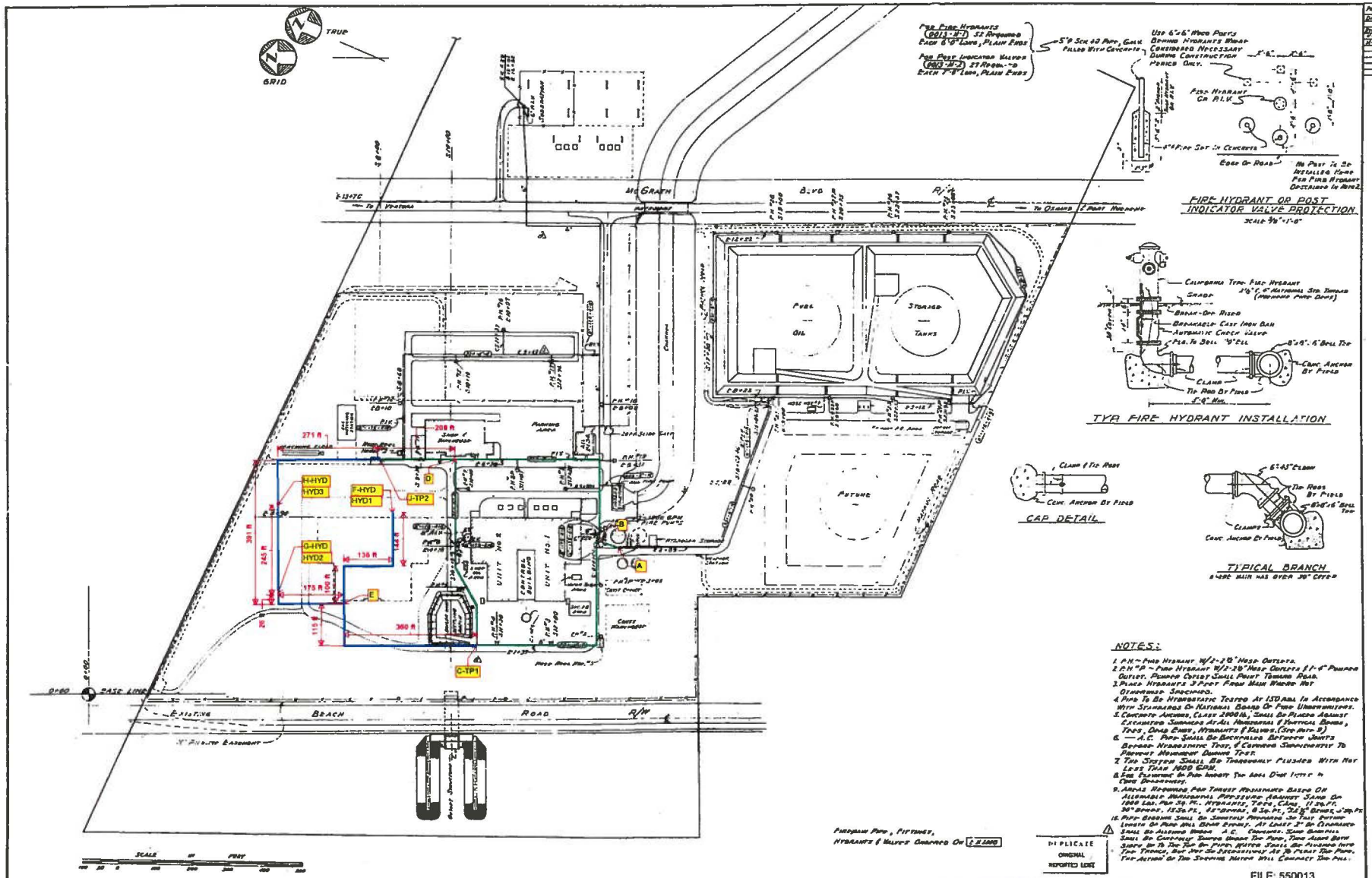
FIREWATER LOOP

NRG
Puente Power Project
Oxnard, California

April 2015

FIGURE 2.7-9


546092
SERVICE WATER TANK 40'-0" I.D. x 48'-0" HIGH
SECTION 'B-B'
SECTION 'A-A'
SECTION F-F
SECTION 'C-C'
SECTION 'D-D'
SECTION E-E
TANK
PMP15-S
PMP15-D
S-MAIN
approx. 514+94.1
FIRE PUMP SUCTION
SERVICE WATER PUMP SUCTION
6" FILL CONN.
EDGE OF ROADWAY
EDGE OF CONCRETE
TOP OF DUCT BELOW 10.25
Notes
1 Δ INDICATES MATERIAL SHALL BE SUPPLIED BY MFR. OF ASSOCIATED EQUIPMENT
2 ALL INSTRUMENT CONNS. SHALL BE ½ 3000# MI SCREWED UNLESS OTHERWISE NOTED
3 ALL GASKETS TO BE 1/16" THICK UNLESS OTHERWISE NOTED
4 INDICATES FIELD WELD
CROSS REFERENCES
REVISIONS
7 RECORD REVISION
6 AS BUILT
1 GENERAL REVISION
LOCATION MANDALAY STEAM STATION
PIPING OUTSIDE AREAS
PLAN & SECTIONS
SERVICE WATER TANK & PUMPS
SOUTHERN CALIFORNIA EDISON COMPANY
LOS ANGELES, CALIF.
SCALE 3/8"=1'-0"
BECHTEL CORPORATION
JOB 2660
550653-7
M 2



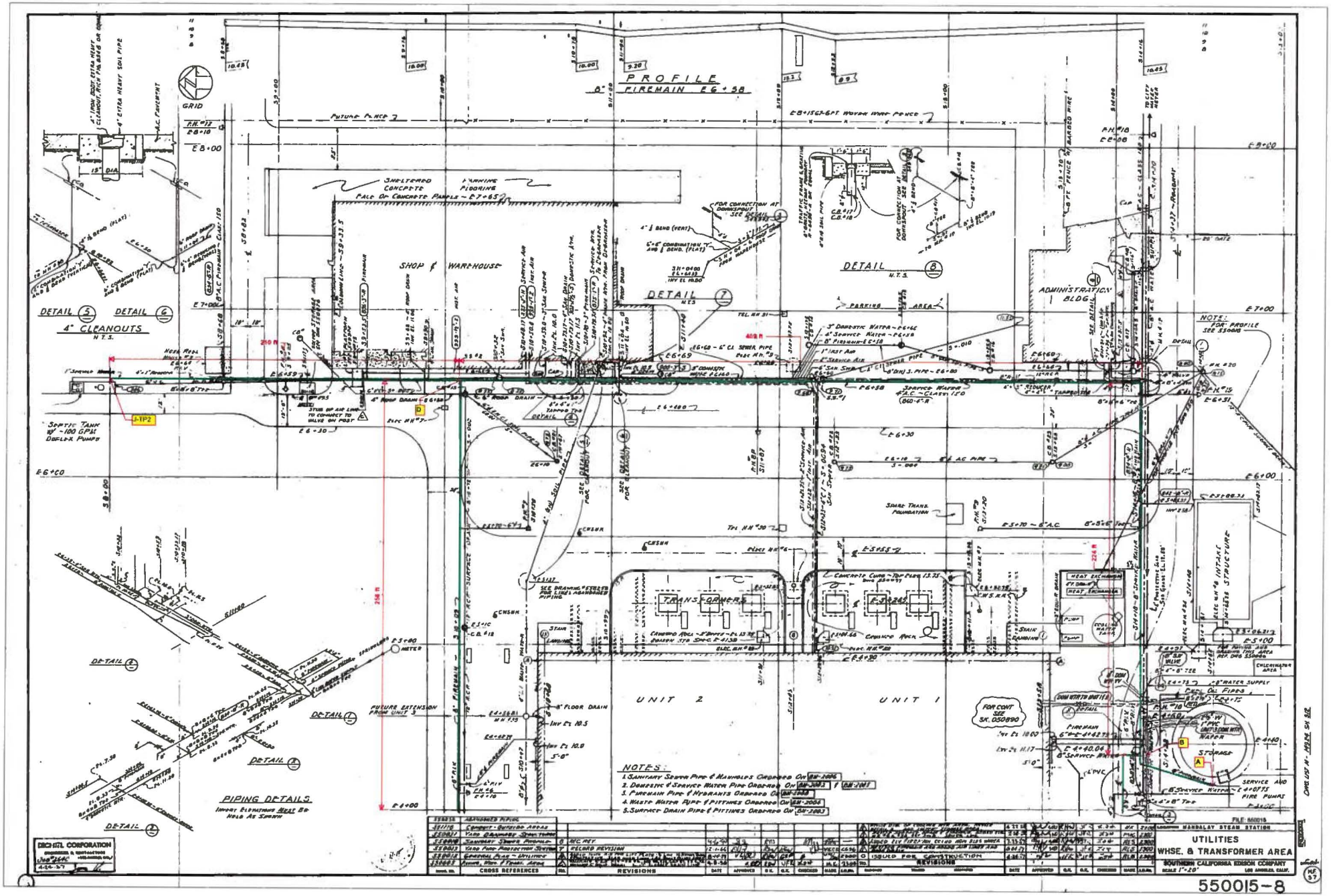
FILE: 550013

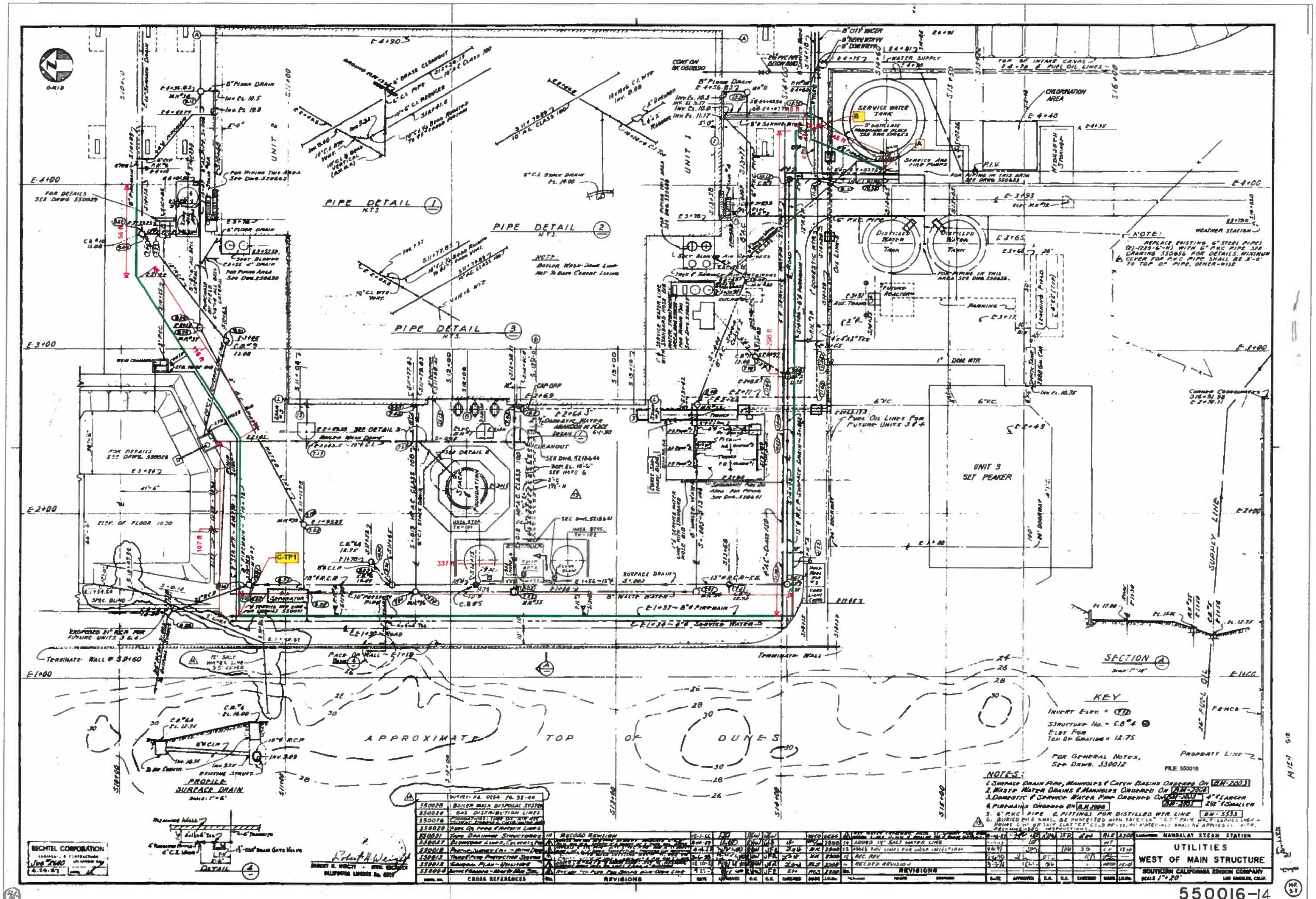
YARD FIRE PROTECTION SYSTEM

SOUTHERN CALIFORNIA EDISON COMPANY

MOHAVE STEAM STATION

550013-4


PROFILE
8" FIREMAIN E6+58
SHOP & WAREHOUSE
ADMINISTRATION BLDG
DETAIL 5
DETAIL 6
4" CLEANOUTS
N.T.S.
DETAIL 7
DETAIL 8
U.T.S.
TRANSFORMERS
UNIT 2
UNIT 1
PIPING DETAILS
NOTES:
1. Sanitary Sewer Pipe & Manholes Ordered On SW-2005
2. Domestic & Service Water Pipe Ordered On SW-2003 & SW-2017
3. Firemain Pipe & Hydrants Ordered On SW-2002
4. Waste Water Pipe & Fittings Ordered On SW-2004
5. Surface Drain Pipe & Fittings Ordered On SW-2003
FOR CONT SEE SK. 050890
NOTE: FOR PROFILE SEE 550048
UTILITIES
WHSE. & TRANSFORMER AREA
SOUTHERN CALIFORNIA EDISON COMPANY
MANDALAY STEAM STATION
550015-8


PIPE DETAIL 1
PIPE DETAIL 2
PIPE DETAIL 3
UNIT 1
UNIT 2
UNIT 3
SET PEAKER
SERVICE WATER TANK
DISTILLED WATER TANK
CHLORINATION AREA
HYDROGEN STORAGE
APPROXIMATE TOP OF DUNES
SECTION A
KEY
PROFILE SURFACE DRAIN
DETAIL
NOTES
SUPPLY LINE
FENCE
PROPERTY LINE
C-TP1
BECHTEL CORPORATION
CROSS REFERENCES
REVISIONS
MANDALAY STEAM STATION
UTILITIES
WEST OF MAIN STRUCTURE
SOUTHERN CALIFORNIA EDISON COMPANY
SCALE 1" = 20'
550016-14

APPENDIX B – Hydraulic Calculation Printout

DATE: 5/18/2016MENTS\1FPE FILES\N\NRG - PUENTE\NRG 3 HYD FLOWING-REV1.SDF
JOB TITLE: NRG PUENTE UGRD EXTENSION 3 HYDRANTS REV1

WATER SUPPLY DATA

SOURCE NODE TAG	STATIC PRESS. (PSI)	RESID. PRESS. @ (PSI)	FLOW (GPM)	AVAIL. PRESS. @ (PSI)	TOTAL DEMAND (GPM)	REQ'D PRESS. (PSI)
TANK	(N/A)	0.0	(N/A)	0.0	1000.0	

AGGREGATE FLOW ANALYSIS:

TOTAL FLOW AT SOURCE	1000.0 GPM
TOTAL HOSE STREAM ALLOWANCE AT SOURCE	0.0 GPM
OTHER HOSE STREAM ALLOWANCES	1000.0 GPM
TOTAL DISCHARGE FROM ACTIVE SPRINKLERS	0.0 GPM

NODE ANALYSIS DATA

NODE TAG	ELEVATION (FT)	NODE TYPE	PRESSURE (PSI)	DISCHARGE (GPM)
S-MAN	3.0	- - - -	-1.7	- - -
P1S-S	3.0	- - - -	-2.1	- - -
P1S-D	3.0	- - - -	122.9	- - -
A1	-5.0	- - - -	122.9	- - -
A	-5.0	- - - -	122.8	- - -
B	-5.0	- - - -	122.2	- - -
C-TP1	-5.0	- - - -	121.0	- - -
D	-5.0	- - - -	121.0	- - -
E	-5.0	- - - -	120.1	- - -
F-HYD	-5.0	- - - -	119.9	- - -
HYD1	3.0	HOSE STREAM	116.2	250.0
G-HYD	-5.0	- - - -	120.0	- - -
HYD2	3.0	HOSE STREAM	116.3	250.0
H-HYD	-5.0	- - - -	120.0	- - -
HYD3	3.0	HOSE STREAM	115.8	500.0
J-TP2	-5.0	- - - -	120.6	- - -
TANK	0.0	SOURCE	0.0	1000.0

PIPE DATA

PIPE TAG / END NODES	ELEV. (FT)	NOZ. (K)	PT (PSI)	DISC. (GPM)	Q(GPM) VEL(FPS)	DIA(IN) HW(C) FL/FT	LENGTH (FT)		PRESS. SUM. (PSI)
Pipe: 1					1000.0	10.020 PL	40.10	PF	0.4
TANK	0.0	SRCE	0.0	(N/A)	4.1	120 FTG	2ETG	PE	-1.3
S-MAN	3.0	0.0	-1.7	0.0		0.003 TL	139.10	PV	
Pipe: 2					1000.0	10.020 PL	15.40	PF	0.4
S-MAN	3.0	0.0	-1.7	0.0	4.1	120 FTG	3ETG	PE	0.0
P1S-S	3.0	0.0	-2.1	0.0		0.003 TL	136.40	PV	
Pipe: 3			FIRE PUMP		Rating:	1000.0 gpm @ 120.0 psi			
P1S-S	3.0	0.0	-2.1	0.0	Avail.:	1000.0 gpm @ 125.0 psi			
P1S-D	3.0	0.0	122.9	0.0	Req'd.:	1000.0 gpm @ 125.0 psi			
User Defined Pump Curve:			gpm	psi	gpm	psi			
			0.0	136.0	1000.0	125.0			
			250.0	133.0	1500.0	95.0			
			500.0	131.0					
Pipe: 4					1000.0	6.280 PL	30.60	PF	3.4
P1S-D	3.0	0.0	122.9	0.0	10.4	140 FTG	3ECG	PE	3.5
A1	-5.0	0.0	122.9	0.0		0.022 TL	152.60	PV	
Pipe: 4A					1000.0	8.390 PL	19.20	PF	0.1
A1	-5.0	0.0	122.9	0.0	5.8	140 FTG	----	PE	0.0
A	-5.0	0.0	122.8	0.0		0.005 TL	19.20	PV	
Pipe: 5					1000.0	8.390 PL	51.00	PF	0.6
A	-5.0	0.0	122.8	0.0	5.8	140 FTG	TG	PE	0.0
B	-5.0	0.0	122.2	0.0		0.005 TL	117.00	PV	
Pipe: 6					493.0	8.390 PL	643.00	PF	1.1
B	-5.0	0.0	122.2	0.0	2.9	140 FTG	2ET2G	PE	0.0
C-TP1	-5.0	0.0	121.0	0.0		0.001 TL	778.00	PV	
Pipe: 7					-19.3	8.390 PL	537.00	PF	0.0
C-TP1	-5.0	0.0	121.0	0.0	0.1	140 FTG	ET2G	PE	0.0
D	-5.0	0.0	121.0	0.0		0.000 TL	641.00	PV	
Pipe: 8					-507.0	8.390 PL	633.00	PF	1.1
D	-5.0	0.0	121.0	0.0	2.9	140 FTG	ET2G	PE	0.0
B	-5.0	0.0	122.2	0.0		0.002 TL	737.00	PV	
Pipe: 9					487.7	8.390 PL	210.00	PF	0.4
D	-5.0	0.0	121.0	0.0	2.8	140 FTG	T2G	PE	0.0
J-TP2	-5.0	0.0	120.6	0.0		0.001 TL	283.00	PV	
Pipe: 10					487.7	8.390 PL	391.00	PF	0.6
J-TP2	-5.0	0.0	120.6	0.0	2.8	140 FTG	EG	PE	0.0
H-HYD	-5.0	0.0	120.0	0.0		0.001 TL	429.00	PV	

DATE: 5/18/2016MENTS\1FPE FILES\N\NRG - PUENTE\NRG 3 HYD FLOWING-REV1.SDF
JOB TITLE: NRG PUENTE UGRD EXTENSION 3 HYDRANTS REV1

PIPE TAG / END NODES	ELEV. (FT)	NOZ. (K)	PT (PSI)	DISC. (GPM)	Q(GPM) VEL(FPS)	DIA(IN) HW(C) FL/FT	LENGTH (FT)		PRESS. SUM. (PSI)
Pipe: 11					500.0	6.280 PL	40.00	PF	0.7
H-HYD	-5.0	0.0	120.0	0.0	5.2	140 FTG	ETG	PE	-3.5
HYD3	3.0	H.S.	115.8	500.0		0.006 TL	114.00	PV	
Pipe: 12					-12.3	8.390 PL	245.00	PF	0.0
H-HYD	-5.0	0.0	120.0	0.0	0.1	140 FTG	G	PE	0.0
G-HYD	-5.0	0.0	120.0	0.0		0.000 TL	252.00	PV	
Pipe: 13					250.0	6.280 PL	40.00	PF	0.2
G-HYD	-5.0	0.0	120.0	0.0	2.6	140 FTG	ETG	PE	-3.5
HYD2	3.0	H.S.	116.3	250.0		0.002 TL	114.00	PV	
Pipe: 14					-262.3	8.390 PL	201.00	PF	0.1
G-HYD	-5.0	0.0	120.0	0.0	1.5	140 FTG	EG	PE	0.0
E	-5.0	0.0	120.1	0.0		0.000 TL	239.00	PV	
Pipe: 15					250.0	8.390 PL	379.00	PF	0.2
E	-5.0	0.0	120.1	0.0	1.5	140 FTG	2ETG	PE	0.0
F-HYD	-5.0	0.0	119.9	0.0		0.000 TL	507.00	PV	
Pipe: 16					250.0	6.280 PL	40.00	PF	0.2
F-HYD	-5.0	0.0	119.9	0.0	2.6	140 FTG	ETG	PE	-3.5
HYD1	3.0	H.S.	116.2	250.0		0.002 TL	114.00	PV	
Pipe: 17					-512.3	8.390 PL	475.00	PF	0.9
E	-5.0	0.0	120.1	0.0	3.0	140 FTG	ET2G	PE	0.0
C-TP1	-5.0	0.0	121.0	0.0		0.002 TL	579.00	PV	

NOTES (HASS):

(1) Calculations were performed by the HASS 8.5 computer program under license no. 50070367 granted by
HRS Systems, Inc.
208 Southside Square
Petersburg, TN 37144
(931) 659-9760

(2) The system has been calculated to provide an average imbalance at each node of 0.014 gpm and a maximum imbalance at any node of 0.057 gpm.

(3) Total pressure at each node is used in balancing the system. Maximum water velocity is 10.4 ft/sec at pipe 4.

(4) The Minimum pump suction pressure under maximum calculated demand is -2.14 (psi)

(5) Items listed in bold print on the cover sheet

are automatically transferred from the calculation report.

(6) Available pressure at source node TANK under full flow conditions is 0.00 psi compared to the minimum required pressure of 0.00 psi.

(7) PIPE FITTINGS TABLE

Pipe Table Name: STANDARD.PIP

PAGE: A MATERIAL: S40 HWC: 120

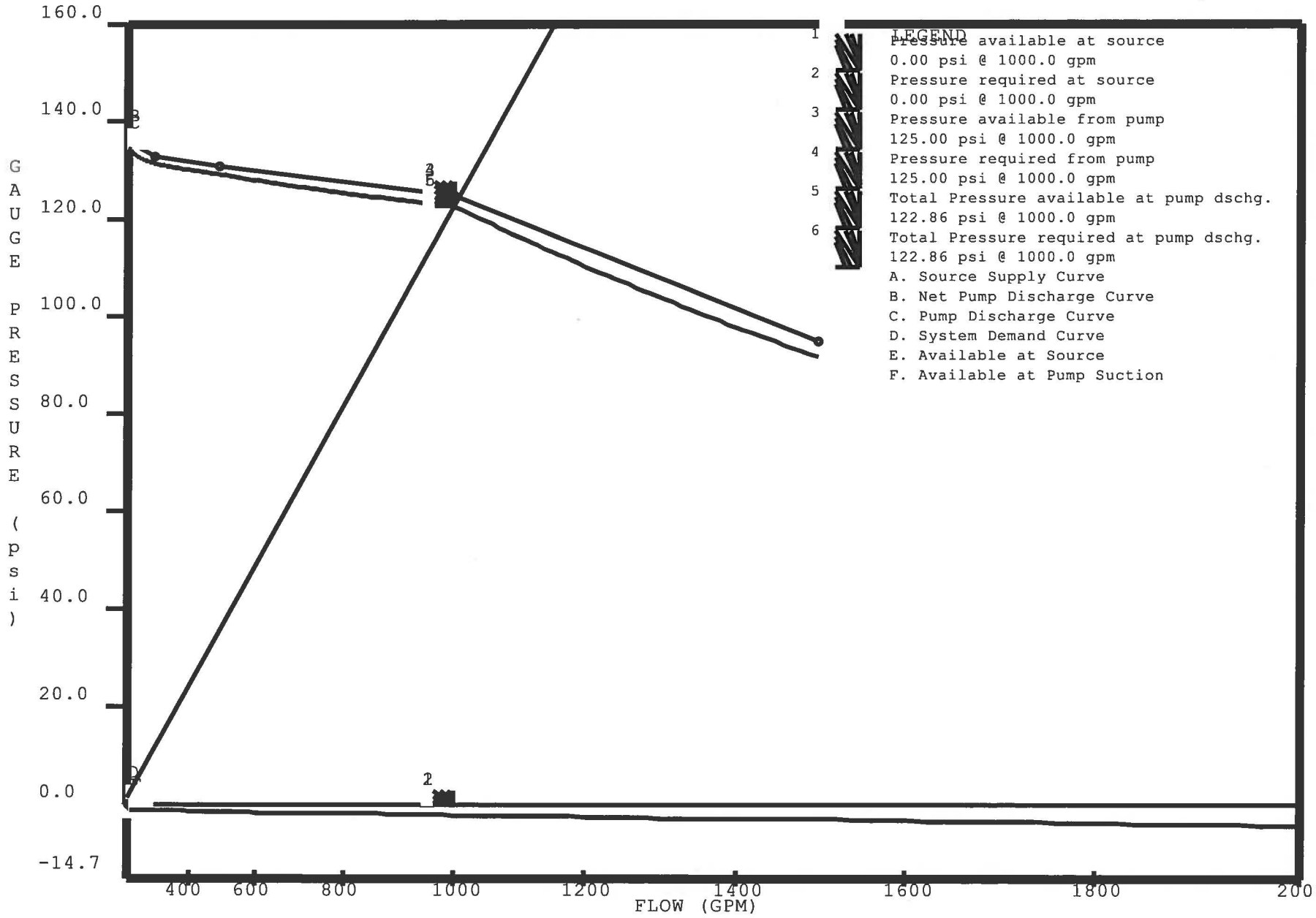
Diameter (in)	Equivalent Fitting Lengths in Feet								
	E Ell	T Tee	L LngEll	C ChkVlv	B BfyVlv	G GatVlv	A AlmChk	D DPVlv	N NPTee
10.020	22.00	50.00	16.00	55.00	19.00	5.00	37.00	37.00	50.00

PAGE: D MATERIAL: DIRON HWC: 140

Diameter (in)	Equivalent Fitting Lengths in Feet						
	E Ell	T Tee	L LngEll	C ChkVlv	B BfyVlv	G GatVlv	N NPTee
6.280	22.00	47.00	14.00	51.00	16.00	5.00	47.00
8.390	31.00	59.00	22.00	76.00	20.00	7.00	59.00

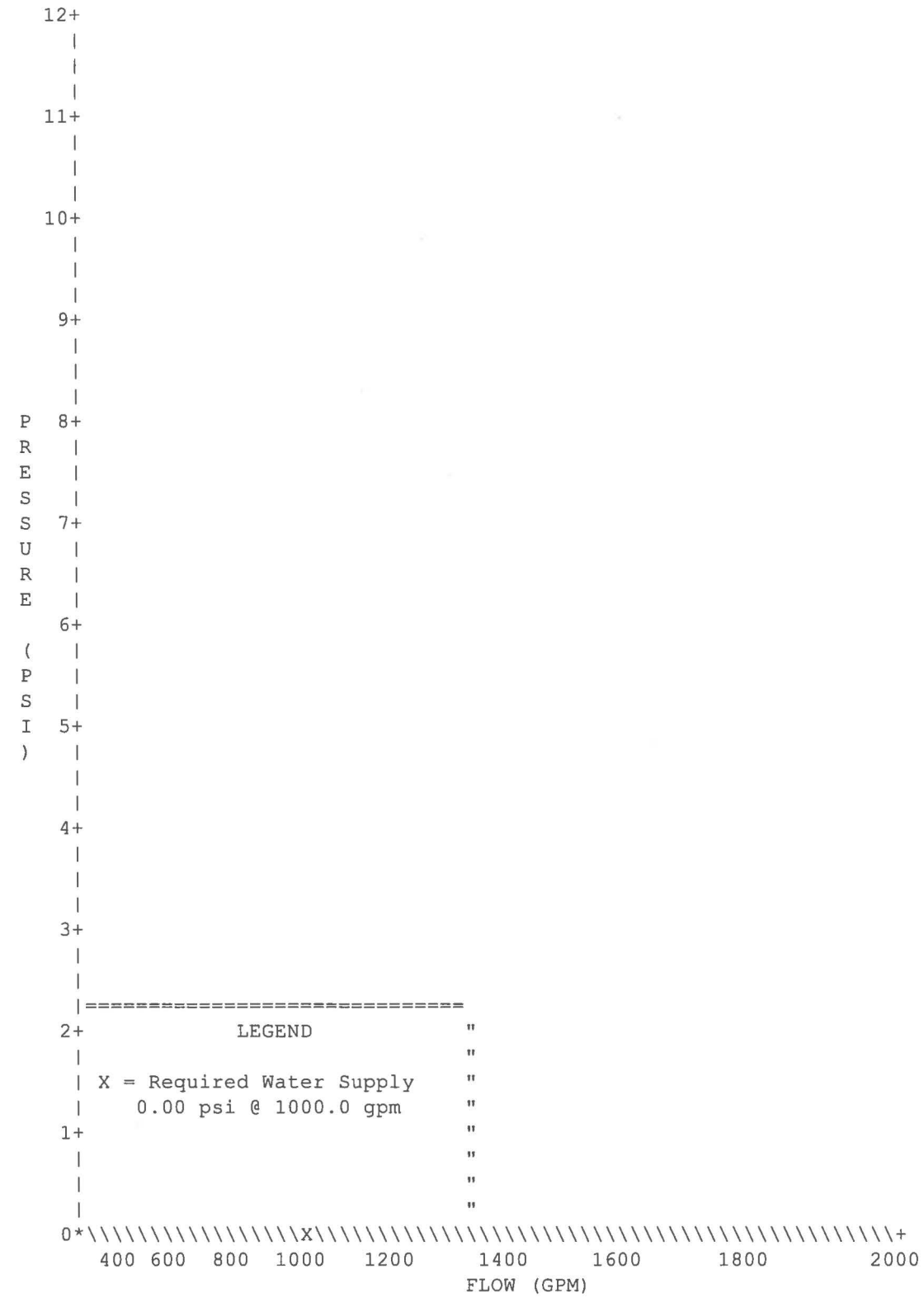
WATER SUPPLY ANALYSIS

Fixed Source Pressure: 0.00 psi



Note: (1) Dashed Lines indicate extrapolated values from Test Results
(2) On Site pressures are based on hose stream deduction at the source

WATER SUPPLY CURVE



APPENDIX C - Client System and Equipment Data

MANDALAY STEAM STATION
UNITS I & 2
MECHANICAL SECTION
SYSTEM DESCRIPTION NO.14
SERVICE WATER SYSTEM

Refer: Service Water, Water Treatment, and Chemical Feed System P & I Diagram B50868.

A. General

The service water system is common to both units. It consists of one service water storage tank, one service water pump and supply headers.

Fresh water for the service water system is obtained from the City of Oxnard through a metered water supply line. The service water system supplies fresh water to the makeup water softening system, fire protection system and all general and domestic uses throughout the station.

The fresh water is conducted from the city water main through a flow meter and pipeline (847) to the service water tank and the station supply header (848). The water meter is located in a meter vault inside the station property line. A check valve is located upstream of the water meter to prevent backflow into the City of Oxnard water mains.

Water supply to the Administration Building, warehouse, garage and station domestic service is conducted through supply lines (900) and (901) which are connected into header (847) between the water meter and the service water tank.

Normally the water is supplied to the service system at city water supply pressure through header (848), by-passing the storage tank and water pump°

The Service Water Pump takes Suction from the service water storage section of the service water tank. When started, the pump maintains pressure in the system lines beyond the pump effecting closure of the check valve in the normal city water flow line. The manual control switch located on the station mechanical control board in the control room may stop the service water pump.

The fresh water fire protection system is normally supplied with water through line (851) connected to line (852), which ties to service water header (847). (See System Description No. 16).

In addition to the domestic and general service water uses, service water is distributed from header (858) to other equipment as follows:

Line (814) to Sampling System Sample Coolers
Lines (861) and (873) Circulating Water Pump Stuffing Box Packing
Lines (864) and (865) H.P. Heater Drain Pumps Quenching Glands
Line (882) Condensate Booster Pumps Quenching Glands
Lines (859) and (866) Condenser Service Stations
Lines (860), (870) and (887) Boiler Wash Water Sump Pump Bearing Lubrication
Line (861) Chlorinator

MANDALAY STEAM STATION
UNITS I & 2
MECHANICAL SECTION
SYSTEM DESCRIPTION NO.14
SERVICE WATER SYSTEM

The water treatment equipment is normally served directly from the service water tank through line (870). During periods of low city water header, pressure, the service water pump supplies the water treatment equipment through line (886). (See System Description No. 9.)

Pressure transmitter (PT-16) located in supply header (858) transmits the service water header pressure to indicator (PI-I) on the station mechanical board. Low-pressure alarm (LPA-8) annunciates in the control room.

B. Service Water Tank

The total storage capacity of the tank is 445,000 gallons, of which approximately 96,000 gallons is reserved for fire fighting use.

Inflow to the tank from the city water supply line is regulated by level control valve (VLC-21) in line (847) controlled by level controller (LC-23) on the tank. High and low level alarms (HLA-3 and LLA-4) give warnings on the mechanical board in the control room and on the DCS chemical screen.

Level gage (L-20) is mounted locally on the tank.

C. Service Water Pump

One single stage centrifugal pump is supplied for the service water system. The pump is rated at 660 gpm at a differential pressure of i00 psi, and is driven by a 60 hp motor. The pump can be started and stopped from the mechanical board in the control room.

MANDALAY STEAM STATION
UNITS 1 & 2

MECHANICAL SECTION
SYSTEM DESCRIPTION NO.16
FIRE PROTECTION SYSTEM

Refer:
Service Water and Fire Protection P & I Diagram B-50868
General Arrangement Fire Protection, Plan Elev. 14 Foot 550670
General Arrangement Fire Protection, Plan Elev. 32 Foot and Above 550671
Yard Fire Protection 550013
Misc. Building Enclosures I, 2 and 3 549985
Administration Building Floor Plan 549961
Shop & Warehouse Building, Floor Plan 549974

A. General

The fire protection facilities are designed to serve the entire steam station, which includes the power station area, switchyard area, administration building, and shop and warehouse buildings.

The power station area is divided into the yard area and the power station interior; Fresh water normally will be supplied to the yard hydrant system for the protection of the main transformers, turbine lube oil storage tanks and the secondary fuel oil area.
In the event of loss of the fresh water supply, the system can be charged with salt water.

In the power plant interior, Dry Chemical Extinguishers are the principal means of general plant fire protection. In addition, a steam smothering system is provided for the fire protection of the turbine lagging enclosures and turbine front standard.

Water supplied from hydrants on the water loop around the fuel storage tanks is the principal means of fire protection in the area. Additional protection is provided by means of a portable mechanical foam pro-portioner located in the hose house in this area.

The switchyard protection consists of a piping loop with hydrants around the area.

The administration building and the shop and warehouse buildings are protected on the outside by fire hydrants located on the water mains around the power station area. Inside hose stations are provided for the shop and warehouse building.

There are two hose houses, advanageously located in the station, hose house one is in or around assembly area one and hose house number two is located in or around assembly area two.. The houses provide storage facilities for a (1) portable, carriage mounted, 150 pound cylinder of a dry chemical type fire extinguishing agent, (2) hose cart equipped with 1-1/2 inch and 2-1/2 inch fire hose and (3) general fire fighting equipment such as spanner wrenches, play pipes and combination spray and stream nozzles

MANDALAY STEAM STATION
UNITS 1 & 2

MECHANICAL SECTION
SYSTEM DESCRIPTION NO.16
FIRE PROTECTION SYSTEM

B. Fresh Water System and Fire Pumps

Fresh water is normally supplied to the plant property at a pressure of approximately 50 psi by the City of Oxnard water mains, which is barely sufficient pressure for the use of a single hydrant. If it is required that two or more hydrants be used, it will be necessary to use a fire pump. A single fire pump is normally used, but in case of high demand two pumps can be operated.

The pumps take supply from the 448,400-gallon service water tank, which has a positive reserve of 102,000 gallons of water for use in case of fire. Based upon two hoses in operation (250 GPM each), there is approximately 3-1/2 hours reserve. Fresh water will be discharged from the fire pumps into an underground distribution system to supply hydrants in separate closed loops around the power plant area, and switchyard area.

Water will also be supplied through branch lines from the loop to interior hose reel stations in the power station and shop and warehouse building.

Two fire pumps are installed and each pump unit is an Approved Fire Underwriters' motor driven type, rated at 120-psi pressure with a capacity of 1000 gpm. Remote switches on the station mechanical board may manually operate them. Pressure transmitter (PT-17) transmits the pressure in the loop to (PI-2) on the station mechanical board.

The pumps are sized to supply a minimum pressure of 60 psi at any hydrant when four hydrants are in operation and a maximum pressure of 118 psi at the hydrant with a single hydrant in operation when both pumps are in service°

C. Piping and Hose

Underground piping is transite pipe with ring type couplings, except in heavily traveled areas, where the piping is Class 150 bell and spigot cast iron. Each hydrant in the system is a California wet barrel type having two 2-1/2 inch outlets with independently operated valves. Pumper connections are provided on hydrants on each loop header.

All fire hose will be rubber lined, double cotton covered, 1-1/2 inches N.S.T. diameter for nozzle use and 2-1/2 inch N.S.T. diameter for use as leader line from hydrants. Hose nozzles will be Underwriters' approved all-purpose nozzles. Canvas covers for fire hose and nozzles will be provided where the hose is located outdoors°

MANDALAY STEAM STATION
UNITS 1 & 2

MECHANICAL SECTION
SYSTEM DESCRIPTION NO.16
FIRE PROTECTION SYSTEM

D. Salt Water Emergency Pump

In the event of the loss of the fresh water supply, the underground distribution system can be supplied with salt water from the discharge manifold of the screen wash pump located in the combined intake and pump structure; this pump is rated 86 psi with a capacity of 1000 gpm and is manually started and stopped at a push button station located on the screen well control board.

This pump is coupled to an internal combustion engine through a manually engaging clutch that will be used in case of loss of electric power. The engine will operate on diesel fuel and will include a manual electric starter with a charging generator. It is started locally.

E. Area & Fire Protection Facilities

Power Station Yard Area

The primary means of combating fires in the yard area will be with water supplied from hydrants on the underground distribution system. Dry chemical type, fire-extinguishing agents can be provided at the scene of a fire by a carriage mounted, 150-pound cylinder and smaller 20-pound portable hand units. Low velocity water fog discharged from all-purpose hose nozzles coupled to nearby hydrants can be used for fighting fires at the turbine lube oil storage tanks.

Water can be a. supplied for fire fighting at the main transformer and secondary fuel oil area from fire hydrants in the plant area. The fire hydrant located on the turbine deck overlooking the main transformers may be used for additional coverage. Dry chemical fire extinguishing agent can be supplied at the scene by the large portable units located in the power station and warehouse area hose houses. A rock fill has been placed in the main transformer area to aid in extinguishing the burning transformer oil and to prevent the oil from accumulating on the surface.

Small portable dry chemical extinguishers are located adjacent to special hazard areas such as the secondary fuel oil pump area, gas metering station and major pumping equipment.

Since the hydrogen storage area is located remotely from any other hazard, no special means of protection is provided°

MANDALAY STEAM STATION
UNITS 1 & 2

MECHANICAL SECTION
SYSTEM DESCRIPTION NO.16
FIRE PROTECTION SYSTEM

E. Area Fire Protection Facilities – Continued

Power Station Interior

Fire protection facilities in the interior of the power station will consist of hose reel stations, a dry pipe spray sprinkler system in the turbine lube oil and seal oil unit areas, portable dry chemical type fire extinguishers, and CO_2 extinguishers°

These facilities provide general fire protection for the building and also cover specific hazard areas such as the turbine lube oil equipment area and the boiler burner front area. Fire hydrants on the yard distribution system provide additional means of supplying water to fires in the interior of the power station from outside the building.

Small electrical fires may be arrested by the use of portable dry chemical type extinguishers mounted locally. These extinguishers also provide fire protection in the laboratory. Small portable carbon dioxide extinguishers are provided for fire protection in the control room, switchgear rooms, elevator machinery room and gantry crane.

For general fire protection a branch line from the water loop entering the power station building will supply hose reel stations located as shows on the general arrangement drawings. The hose reel stations are equipped with 100 feet of 1-l/2 inch single jacketed rubber lined cotton hose and Underwriters' approved all-purpose nozzles.

A steam smothering system is provided to flood the turbine lagging enclosure with steam in case of a fire; temperature switches HTA-1 and HTA-2 located in the ventilating air stream for each turbine unit will actuate an annunciator in the control room. A valve located on the turbine deck will affect discharge of the system manually. The steam supply is taken from the steam trace system in order to assure continuity of service.

Primary protection for the turbine lube oil equipment area is a spray sprinkler system that will spray water over the turbine lube oil conditioner and reservoir located in the area, The spray nozzles are attached to a loop header that is charged with water from the fire mains by the manual operation of valves in the power station building. A temperature-sensing element located in the area will annunciate in the control room. Floor drains surrounding the lube oil reservoir are provided to carry away the water and any spilled lube oil to the drainage system. Dry chemical wheeled extinguishers may furnish additional protection.

A similar system is installed around the hydrogen seal oil unit in the generator exciter area.

Water for fire protection can also be supplied to this area from hose reel stations located inside the plant.

MANDALAY STEAM STATION
UNITS 1 & 2

MECHANICAL SECTION
SYSTEM DESCRIPTION NO.16
FIRE PROTECTION SYSTEM

E. Area Fire Protection Facilities – Continued

Power Station Interior continued

At the boiler front area, wheeled 150-pound dry chemical units are provided; each is equipped with 100 feet of 3/4-inch hose. Smaller portable units located on the firing aisle will offer additional protection.

Switchyard Area

Hydrants located on a loop around the area serve the switchyard. Fire hose and adjustable nozzles for the hydrants are stored in the hose house at the shop and warehouse area° Additional protection is provided by the large portable dry chemical unit stored in the hose house.

Service Buildings

Protection on the outside of the administration building, warehouse shop building and garage is water supplied from hydrants on the fire mains around the power station area.

Inside fire portable extinguishers of the water type located in the lobby and corridor supply protection for the administration building. Also, there are carbon dioxide extinguishers in the lunchroom and guard station.

Inside, fire protection for the shop and warehouse building consists of hose reel stations for general protection portable dry chemical extinguishers in the welding areas and outside of the paint storage room. Portable water type extinguishers will be located in the warehouse area and locker room. Portable carbon dioxide extinguishers are located in the shop corridor and lunchroom.

Protection for the car shelter consists of a portable dry extinguisher two water type extinguishers and a hose reel station.

PUMP IS GUARANTEED AT DESIGNATED OPERATING POINT ONLY.

PEERLESS PUMP DIVISION

FOOD MACHINERY & CHEMICAL CORPORATION

LOS ANGELES, CALIF. – INDIANAPOLIS, IND.

SIZE OF PUMP 5 AF-10

CURVE NO. 2869311

IMPELLER 35-5AF16-7, 16 5/8"

SPEED 1760 R.P.M.

FILE 74528-H SERIAL 123700

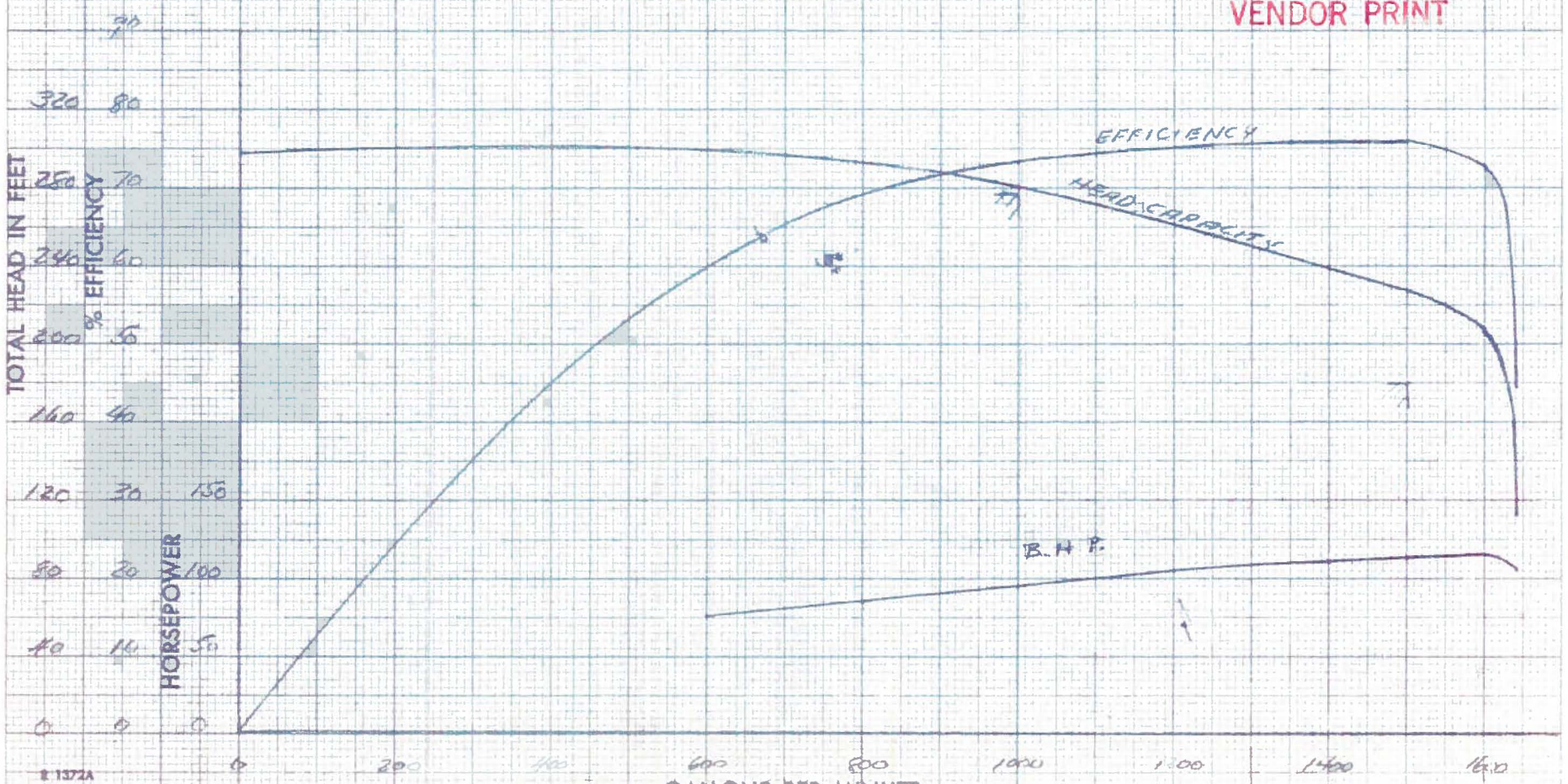
JOB 2640

439 - 14 - 0

VENDOR PRINT

Mandalay Steam Station

CENTRAL FILE



E 1372A

PLOTTED BY MEJ FROM TEST NO. 11-3203 DATE 10-2-57

APPENDIX D - Fire Pump Test Results dated 6-2-15

Inspection, Testing, and Maintenance Fire Pumps **Page 1 of 8**
NFPA 25, Chapter 8 as amended by CCR, Title 19

Date of Inspection, Testing, Maintenance: 6-2-15

Property Information:

Name: NRG Energy Mandalay

Address: 393 North Harbor Blvd

City: Oxnard

Pump ID: South

Serial Number: 5in AF-10

Abbreviation Key:
I = Inspection
T = Test
M = Maintenance
A-O = After Operation
MI = Per Manufacturer's Instructions

Annual Fire Pump Test Results

Date of Pump Test: 6-2-15

Shaft Orientation:
☒ Horizontal
☐ Vertical

Number of pumps at this location: 2
If multiple pumps:
☐ Series arrangement
☒ Parallel arrangement
NOTE: Submit a separate form for each pump

Type of Driver:
☒ Electric
☐ Diesel
☐ Gasoline
☐ Steam
☐ Gas

	Nameplate Data		Test Results				
			Flow (gpm)	***Net Pump Pressure (psi)***	***RPM***	***Volts***	***Amps***
Shutoff Pressure	Manual	psi					
100% Rated Capacity	1000	gpm	0	136	1795	N/A	N/A
100% Rated Pressure	120	psi	500	131	1790	N/A	N/A
150% Rated Capacity	1500	gpm	1000	125	1787	N/A	N/A
65% Rated Pressure	78	psi	1500	95	1784	N/A	N/A
Rated RPM	1760	rpm					

Type of Test:
☒ Discharge to Atmosphere
☐ Recirculation

Test Equipment
☐ Flow Meter / Size: _____
☐ Play pipe (1-1/8")
☒ Play pipe (1-3/4")
☐ Diffuser / Size: _____

Controller:
Manufacturer: Manually Started by Operators
Serial Number: In Operators office.