NORTH END WATER POLLUTION CONTROL CENTRE

CENTRAL HEATING PLANT

OPERATING MANUAL

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TABLE OF CONTENTS

TABLE OF CONTENTS - Cont'd

LIST OF FIGURES

* Follows Previous Figure

LIST OF FIGURES - CONT'D

* Follows Previous Figure

LIST OF TABLES

A. General

The central heating plant for the North End Water Pollution Control Centre is located to the south of digester pipe gallery number 3. The heating plant for the purpose of this manual consists of the primary heat production and distribution equipment for the entire NEWPCC facility. It also includes the auxiliary mechanical and electrical systems that service the plant and the building in which the heating equipment is housed.

B. History

The central heating plant at the North End Water Pollution Control Centre was initally commissioned in 1966 at which time the plant consisted of three 500 Horsepower water tube boilers. These three boilers adequately met the heating requirements from 1966 to 1986. In 1986 the addition of primary digesters 13 and 14 and other plant changes required the addition of a fourth boiler to meet the expanding heating loads of the plant and in particular, sludge heating requirements. The design intention was to be able to maintain at least one of the boilers in full standby at the time of peak facility load.

At the time the fourth boiler was added in 1986 the boiler pumping, plant ventilation, and heating plant controls were upgraded. The basic arrangement and operations of the equipment however were retained through the renovations of 1986. The control of equipment was changed only to the extent required to upgrade instrumentation to 1986 standards and to provide supervisory interface to the central process computer.

C. Functional Summary

The heating plant is to provide heat for the entire plant area including the processes at the North End Water Pollution Control Centre. As shown on Figures No. B101 and No. B102 the system can be split into primary and

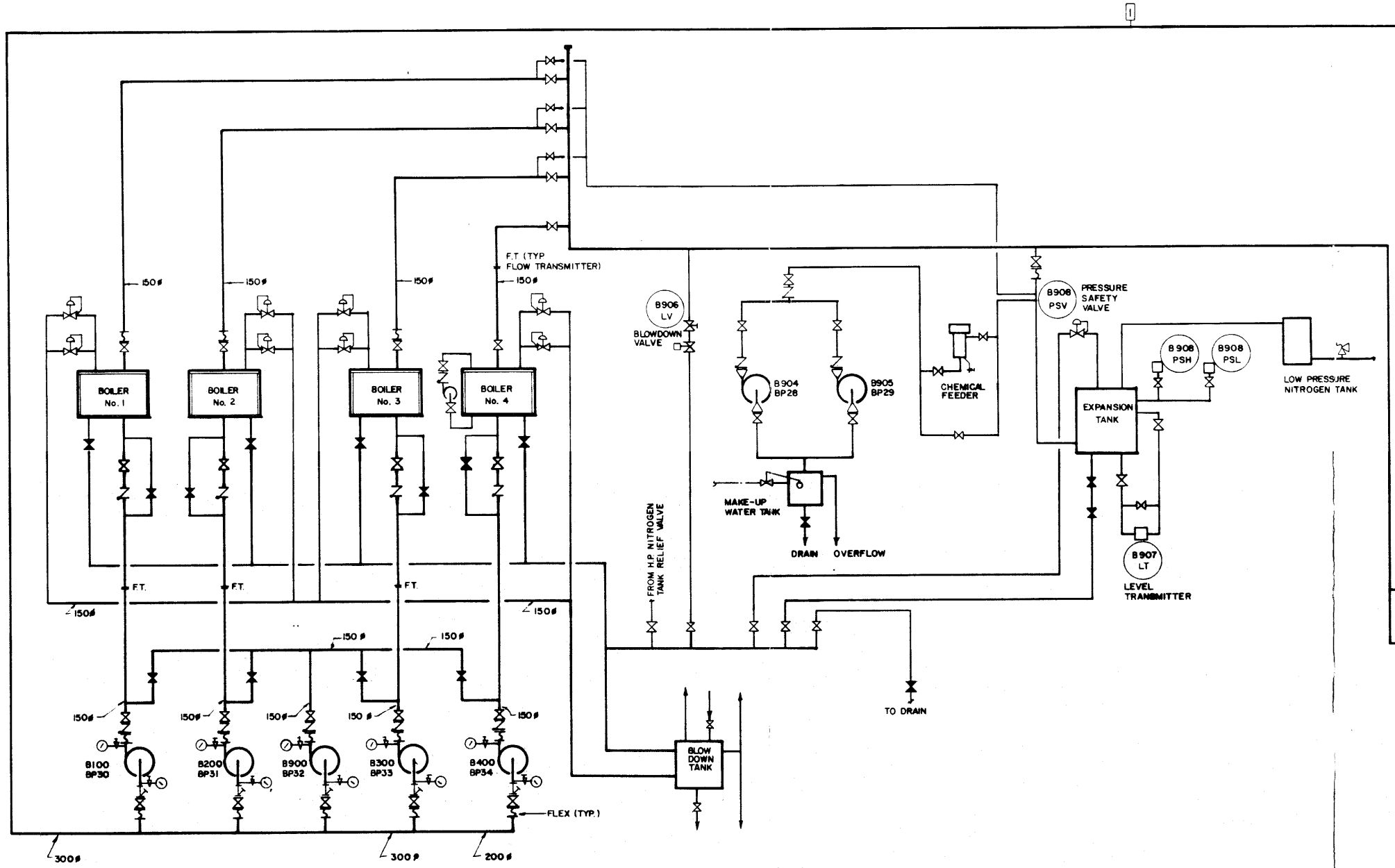
secondary sections at the thermal storage tank. The primary system (Fig. No. B101) includes the boilers and their auxiliaries and is where all heat addition is made. The secondary systems (Fig. No. B102) includes the heat distribution equipment which carries the heat to locations where it is required and then applies the heat as needed.

The primary system includes a boiler circulating pump for each boiler and a common standby boiler pump BP-32 that may be used to supply any boiler. The boiler circulating pumps operate continuously whenever their designated boiler is in a fire ready condition. The pumps ensure proper circulation through the boilers at all times as well as transport the heat production of the boilers to the thermal storage tank. The primary system also includes equipment which provides for pressure and fill control for the entire heating system. A nitrogen over-water expansion tank maintains the system pressure. Level controls in the expansion tank operate the feed pumps BP-28 or BP-29 to maintain system water level.

The secondary system provides the equipment for distribution and application of heating throughout the entire plant. The secondary system components enclosed in the boiler area are the main circulating pumps for each of the five building areas. Each area is provided with two pumps, only one of which must run to maintain required circulation. The five areas supplied are the main building area (BP-43 and BP-44), the digester area (BP-35 and BP-36), the secondary clarifier building (BP-41 and BP-43), the boiler building (BP-38 and BP-39). The secondary system also includes the sludge heating system (BP-20 and BP-21). All secondary systems are pumped from and return to the thermal storage tank.

The thermal storage tank is intended to blend the heated water from the boilers with cool return water from the system to ensure a blended return water temperature to the boilers and blended supply water temperature to the system. The result is to reduce the thermal shock danger to the boilers while also ensuring a constant system water supply temperature to the secondary system.

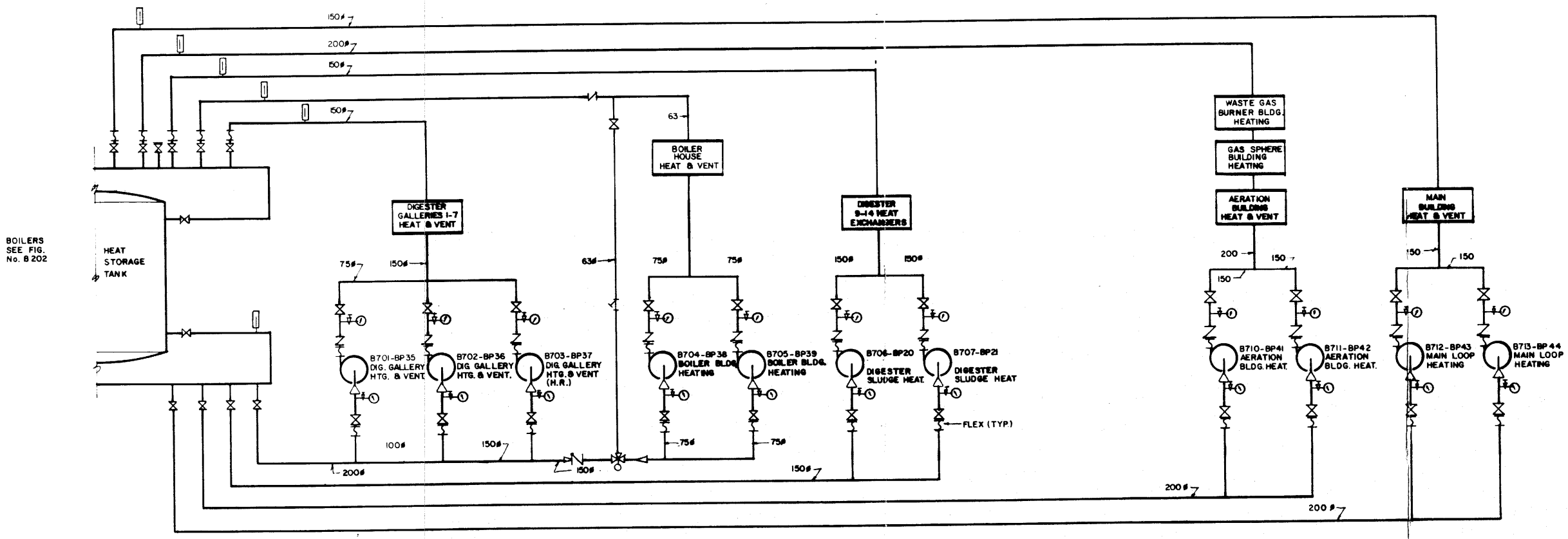
LEGEND	
SYMBOL	DESCRIPTION
	GATE VALVE
	GLOBE VALVE
	VALVE NORMALLY CLOSED
	CHECK VALVE
	PRESSURE REDUCING VALVE
	COMBINATION SHUT-OFF/THROTTELING VALVE
	AUTOMATIC CONTROL VALVE
	PRESSURE RELIEF VALVE
	UNION COUPLING
	PUMP (SCHEMATIC VIEW)
	PET COCK
	THERMOMETER
	PRESSURE GAUGE
AV	AIR VENT
	STEAM TRAP
	PIPELINE STRAINER



HEATING PLANT PRIMARY SYSTEM SCHEMATIC

fig B101.

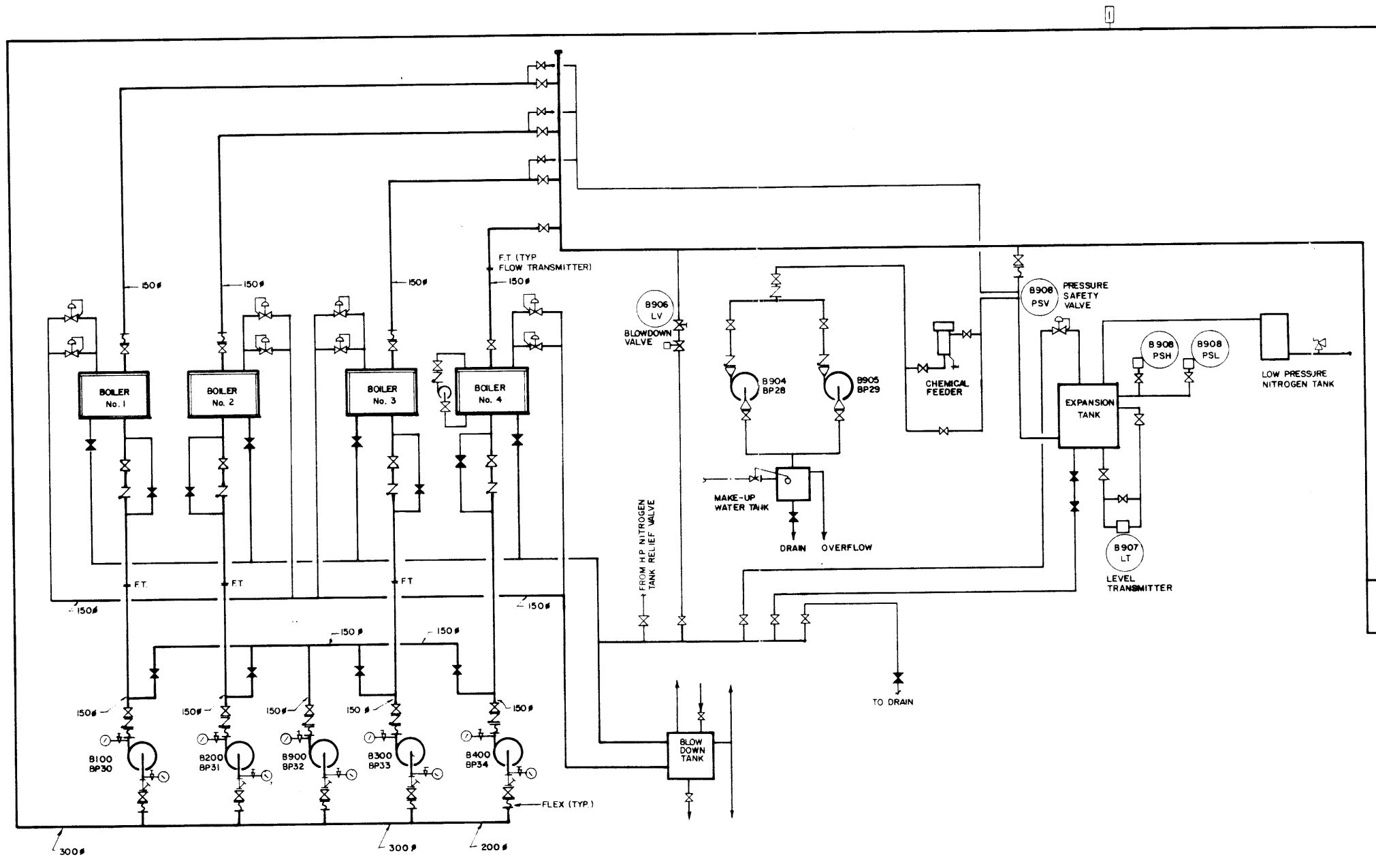
LEGEND	
SYMBOL	DESCRIPTION
	GATE VALVE
	GLOBE VALVE
	VALVE NORMALLY CLOSED
	CHECK VALVE
	PRESSURE REDUCING VALVE
	COMBINATION SHUT-OFF/THROTTELING VALVE
	AUTOMATIC CONTROL VALVE
	PRESSURE RELIEF VALVE
	UNION COUPLING
	PUMP (SCHEMATIC VIEW)
	PET COCK
	THERMOMETER
	PRESSURE GAUGE
AV	AIR VENT
	STEAM TRAP
	PIPELINE STRAINER



HEATING PLANT SECONDARY SYSTEM SCHEMATIC

fig B102

LEGEND	
SYMBOL	DESCRIPTION
	GATE VALVE
	GLOBE VALVE
	VALVE NORMALLY CLOSED
	CHECK VALVE
	PRESSURE REDUCING VALVE
	COMBINATION SHUT-OFF/THROTTELING VALVE
	AUTOMATIC CONTROL VALVE
	PRESSURE RELIEF VALVE
	UNION COUPLING
	PUMP (SCHEMATIC VIEW)
	PET COCK
	THERMOMETER
	PRESSURE GAUGE
AV	AIR VENT
	STEAM TRAP
	PIPELINE STRAINER



HEATING PLANT PRIMARY SYSTEM SCHEMATIC

fig B101.

D. System Components

The heating plant is comprised of major and auxiliary systems. The major elements of the central heating plant system are:

- boilers
- feedwater system
- pressure control system
- pumping systems (primary and secondary)

Auxiliary systems servicing the central heating plant are:

- boiler building heating system
- venting and air conditioning systems
- electrical systems

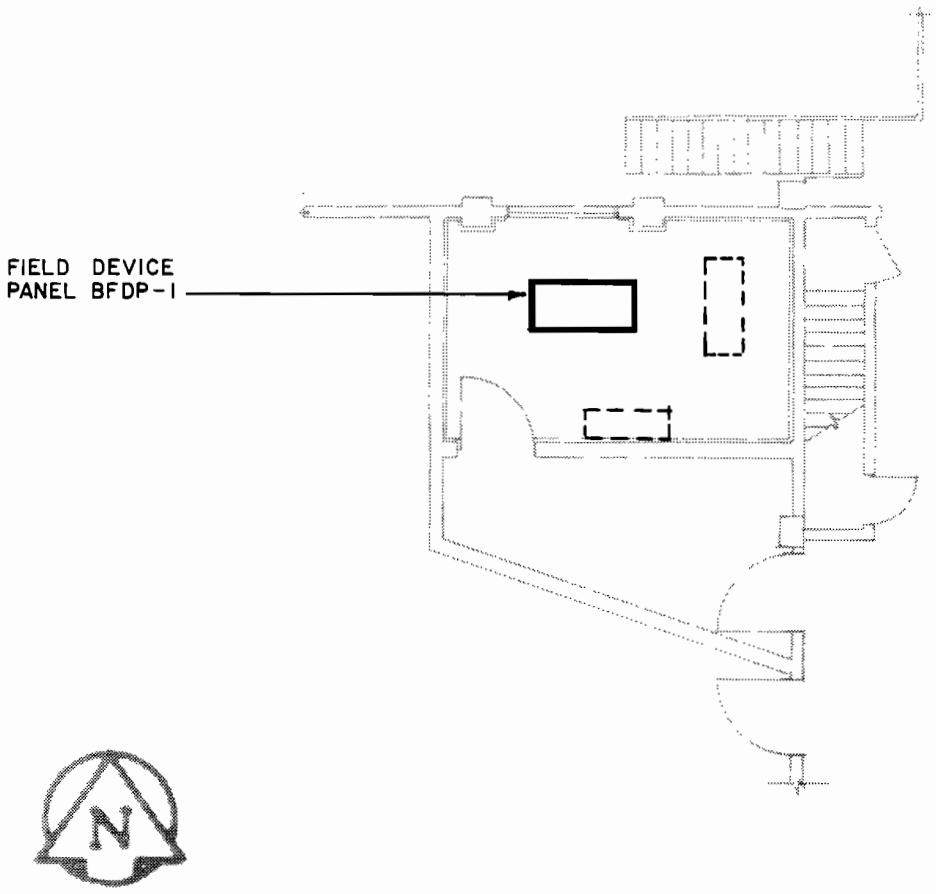
Each of the above components and sub-systems is discussed in its respective section of this manual.

The major mechanical elements of these systems are described in the Equipment Data Synopsis Table B1-1.

E. Plant Control Overview

The heating plant and building services are monitored and controlled through the Boiler Field Device Panel, (see fig. B103).

The control and indication of the field device panel is also available to the central plant control system (Bailey N90). Cross references between the field device panel indication and control and corresponding provisions in the N90 system are also made on figure. B104. The field device panel in the Boiler Control Room (BFDP-1) provides monitoring and control of the following:

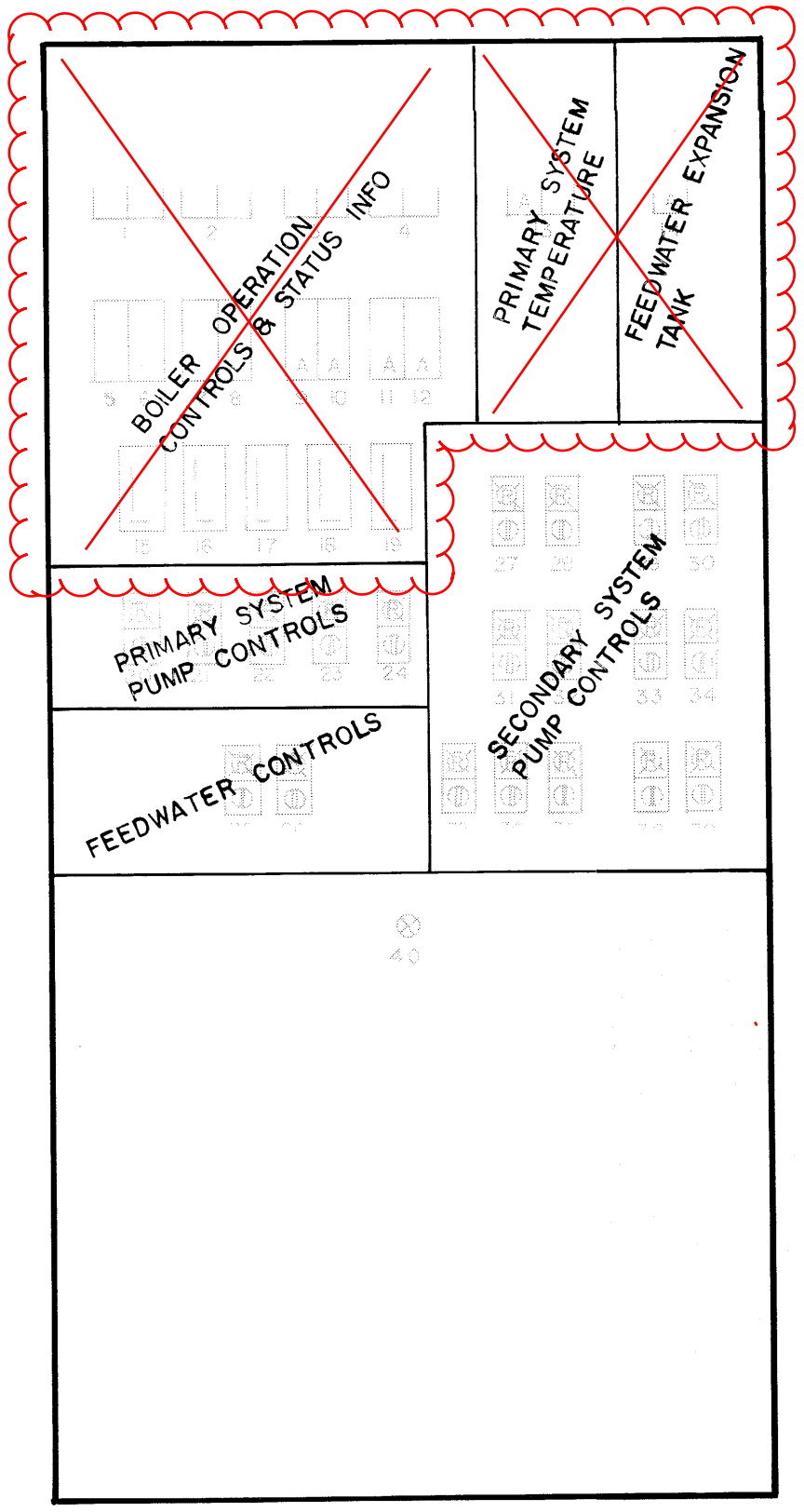


BOILER AREA

CONTROL ROOM LAYOUT

BOILER BUILDING ANNEX
ELEVATION 233.82

fig. B103



1. GAS FLOW TO BOILER No. 1 NATURAL GAS AND SLUDGE GAS FLOW
2. GAS FLOW TO BOILER No. 2 NATURAL GAS AND SLUDGE GAS FLOW
3. GAS FLOW TO BOILER No. 3 NATURAL GAS AND SLUDGE GAS FLOW
4. GAS FLOW TO BOILER No. 4 NATURAL GAS AND SLUDGE GAS FLOW
5. BOILER No. 1 STACK TEMPERATURE
6. BOILER No. 2 STACK TEMPERATURE
7. BOILER No. 3 STACK TEMPERATURE
8. BOILER No. 4 STACK TEMPERATURE
9. BOILER No. 1 WATER FLOW
10. BOILER No. 2 WATER FLOW
11. BOILER No. 3 WATER FLOW
12. BOILER No. 4 WATER FLOW
13. HEATING TEMPERATURES - PRIMARY LOOP - SUPPLY & RETURN
14. EXPANSION TANK LEVEL
15. BOILER No. 1 CONTROLLER
16. BOILER No. 2 CONTROLLER
17. PLANT MASTER
18. BOILER No. 3 CONTROLLER
19. BOILER No. 4 CONTROLLER
20. BOILER No. 1 PUMP B100-2BP31
21. BOILER No. 2 PUMP B200-1BP30
22. STANDBY PUMP B900-2BP32
23. BOILER No. 3 PUMP B300-1BP33
24. BOILER No. 4 PUMP B400-2BP34
25. BOILER MAKE-UP WATER PUMP 904-2BP28
26. BOILER MAKE-UP WATER PUMP B905-1BP29
27. DIGESTER HEATING PUMP B706-2BP20
28. DIGESTER HEATING PUMP B707-1BP21
29. MAIN BUILDING PUMP B712-1BP43
30. MAIN BUILDING PUMP B713-2BP44
31. BOILER BUILDING HEATING PUMP B704-2BP38
32. BOILER BUILDING HEATING PUMP B705-1BP39
33. SECONDARY BUILDING PUMP B710-1BP41
34. SECONDARY BUILDING PUMP B711-2BP42
35. DIGESTION GALLERY HEATING PUMP B701-1BP35
36. DIGESTION GALLERY HEATING PUMP B702-2BP36
37. DIGESTION GALLERY HEATING PUMP B703-1BP37
38. WGB AND SPHERE BUILDINGS HEATING PUMP B708-2DP22
39. WGB AND SPHERE BUILDINGS HEATING PUMP B707-1DP23
40. COMMON ALARM RESET PUSHBUTTON STATION

GRAPHIC DISPLAYS		GROUP DISPLAYS			
DISPLAY NO.	REMOTE CONTROL INDEX NO.	TREND	CONTROL STATION	REMOTE CONTROL SWITCH	SINGLE POINT
10-B		10-B			
10-C		10-C			
10-D		10-D			
10-E		10-E			
10-B		10-B			
10-C		10-C			
10-D		10-D			
10-E		10-E			
10-B		10-B			
10-D		10-C			
10-C		10-D			
10-E		10-E			
10-A,B,C,D,E		10-B,C,D,E,H			10-L
10-A		10-H			10-L
10-B,C,D,E	2	10-B	10-A		
10-B,C,D,E	2	10-C	10-A		
10-B,C,D,E	1	10-B,C,D,E,H	10-A		10-L
10-B,C,D,E	2	10-D	10-A		
10-B,C,D,E	2	10-E	10-A		
10-A,B	4				
10-A,C	4				
10-A,B,C,D,E	5				
10-A,D	4				
10-A,E	4				
10-A					
10-A					
10-F	6				
10-F	7				
10-G	5				
10-G	6				
10-F	4				
10-F	5				
10-G	3				
10-G	4				
10-F	1				
10-F	2				
10-F	3				
10-G	1				
10-G	2				

FOR DETAILED DESCRIPTION OF NET 90 CONTROL REFER TO INSTRUMENTATION & CONTROL MANUAL

LEGEND

SYMBOL	DESCRIPTION
A	FI-FLOW INDICATOR TI-TEMPERATURE INDICATOR PI-PRESSURE INDICATOR LI-LEVEL INDICATOR DI-DENSITY INDICATOR ZI-POSITION INDICATOR A-HI OR LO ALARM
	CONTROLLER
	AMBER PILOT LIGHT TROUBLE INDICATION
	RED PILOT LIGHT RUN INDICATION OR VALVE OPEN INDICATION
	YELLOW PILOT LIGHT LOCAL CONTROL IN USE
	COMPUTER/OFF/HAND THREE-POSITION SELECTOR SWITCH
	"RESET" PUSHBUTTON STATION

BOILER AREA
FIELD DEVICE PANEL-BFDP-1
BOILER AREA CONTROL ROOM

fig B104

TABLE B1-1

EQUIPMENT DATA SYNOPSIS

EQUIPMENT	INDEX	MANUFACTURER	SERVICE	CAPACITY	POWER REQ'T
Boilers	B-1	Dominion Bridge	-	11.60 GJ/Hr Output	
	B-2	Dominion Bridge	-	11.66 GJ/Hr Output	
	B-3	Dominion Bridge	-	11:60 GJ/Hr Output	
	B-4	Cleaner Brooks	-	17.655 GJ/Hr Output	
Pumps	BP-20	Armstrong 1510BH	Digester Heating	16.4 L/S @ 30 KPa	1.5 HP
	BP-21	Armstrong 1510BH	Digester Heating	15.4 L/S @ 30 KPa	1.5 HP
	BP-28	Armstrong K5	Boiler Make-up	1.5 L/S @ 540 KPa	5 HP
	BP-29	Armstrong K5	Boiler Make-up	1.5 L/S @ 540 KPa	5 HP
	BP-30	Armstrong 40P	Boiler Circ.	32 L/S @ 195 KPa	20 HP
	BP-31	Armstrong 40P	Boiler Circ.	32 L/S @ 195 KPa	20 HP
	BP-32	Armstrong 40P	Boiler Circ. (Standby)		20 HP
	BP-33	Armstrong 40P	Boiler Circ.	32 L/S @ 195 KPa	20 HP
	BP-34	Armstrong 40P	Boiler Circ.	72 L/S @ 160 KPa	20 HP
	BP-35	Armstrong 1510BH	Digester Gallary HTG	14.4 L/S @ 90 KPa	3 HP
	BP-36	Armstrong 1510BH	Digester Gallary HTG	14.4 L/S @ 90 KPa	3 HP
	BP-37	Armstrong 1510BH	Digeester Gallary HTG	33.7 L/S @ 150 KPa	15 HP
	BP-38	Armstrong 1510BH	Boiler Bldg. HTG	4.86 L/S @ 150 KPa	2 HP
	BP-39	Armstrong 1510BH	Boiler Bldg. HTG	4.86 L/S @ 180 KPa	2 HP
	BP-40	Armstrong 1510BH			
	BP-41	Armstrong 1510BH	Aeration Bldg. HTG	46.8 L/S @ 150 KPa	15 HP
	BP-42	Armstrong 1510BH	Aeration Bldg. HTG	46.8 L/S @ 150 KPa	15 HP
	BP-43	Armstrong 1510BH	Main Building HTG	42.9 L/S @ 240 KPa	25 HP
	BP-44	Armstrong 1510BH	Main Building HTG	42.9 L/S @ 240 KPa	25 HP
Fans	BF-20		Boiler Room Ventilation	7500 L/S @	
	BF-21	Northern Blower 5300	Boiler Room Ventilation	4800 L/S @ 65 Pa	1.5 HP
	BF-22	Northern Blower 5300	Boiler Room Ventilation	4800 L/S @ 65 Pa	1.5 HP
	BF-23	Circular CRU	Boiler Cont. Rm. A/C	710 L/S @ 250 Pa	0.75 HP
	BF-23A	Circular HDS	Boiler Cont. Rm. A/C	71 L/S @ 485 Pa	1.0 HP
	BF-45	Northern Blower 7693	Boiler Cont. Rm. A/C	40 L/S @ 100 Pa	0.25 HP
	BF-46	Northern Blower 7693	Boiler Area Flare Rm. Vent.	40 L/S @ 100 Pa	0.25 HP
Cooling Condensor	CU #3	Lennox H518 Cont. Room	Boiler Area Cont. Rm. A/C	3 Tons of cooling	4.3 KW
	CU #4	Lennox H518	Boiler Area Cont. Rm. A/C	3 Tons of cooling	4.3 KW

- pump operation (boiler circulation pumps, make-up water pumps, heating pumps)

- flow metering (boiler natural gas, digester gas, water circulation rates)

- temperature (boiler water and stack temperatures, supply and return water)

- boiler operation (boiler controllers, plant controllers)

- system pressure control (expansion system)

- system water feed control

Specific details on the type and location of the panel mounted indicators and control switches for the various pieces of equipment are shown on Fig. B104. Operation of the control devices is discussed in the sections of the manual specific to each major or auxiliary sub-system.

It should be noted that there is no control of the central heating plant ventilation systems at the field devices panel in the boiler room. This equipment can only be controlled from the digester area control room. Information is included in this manual on the operation of these systems. However, for instructions on control, refer to the digester area manual.

F. Alarms

Alarms in the Boiler Area are displayed at the field device panel, BFDP-1 and on the Bailey N90 System Area Control Stations. The alarms displayed on the Baily N90 System includes the alarms shown on BFDP-1 and a number of others including fire alarms, heating and ventilation failures, hazardous gas alarms and various transmitter signal alarms.

Table B1-2 provides a list of the majority of alarms, their display locations, their origins and potential causes, and the operator's appropriate responses. The heating and ventilation system alarms and fire alarms are detailed separately in Section D2400 and Section D2500 of the Digester Building Operating Manual.

The alarms displayed at the BFDP-1 consist mainly of motor fail and system status alarms.

Reset is required for all motor fail alarms but is not required for any of the other alarms displayed at the BFDP-1. A number of alarms are also displayed at the Fire Alarm Panel and Honeywell DDC Panel located in the Digester Control Room.

B700 ALARM CONDITIONS

The following list is provided as a quick reference chart to allow the operator quick identification of alarms and to provide direction on the type of response required.

TABLE B1-2

ALARM	LOCATION	ORIGIN	CAUSE	ACTION REQUIRED
B100-BK	Boiler Panel, N90 Displays 10-A, 10-B, 10-L	Boiler #1 Safety Controller	General operation and safety alarm from Boiler No. 1.	Immediately dispatch operations staff to evaluate shutdown and start standby boiler if necessary.
B121-FT	BFDP-1 Indicator #9	Flow Transmitter Boiler #1 Supply Piping	Flow flow condition to Boiler No. 1 (will be accompanied by a B101-BK alarm).	Immediately dispatch operations staff to evaluate shutdown and start standby boiler if necessary.
B200	Boiler Panel, N90 Displays 10-A, 10-R, 10-L	Boiler #2 Safety Controller	General operation and safety alarm from Boiler No. 2.	Immediately dispatch operations staff to evaluate shutdown and start standby boiler if necessary.
B221-FT	BFDP-1 Indicator #10	Flow Transmitter Boiler #2 Supply Piping	Low flow condition to Boiler No. 2 (will be accompanied by a B201-BK alarm).	Immediately dispatch operations staff to evaluate shutdown and start standby boiler if necessary.
B300	Boiler Panel, N90 Displays 10-A. 10-D, 10-L	Boiler #3 Safety Controller	General operation and safety alarm from Boiler No. 3	Immediately dispatch operations staff to evaluate shutdown and start standby boiler if necessary.
B321-FT	BFDP-1 Indicator #11	Flow Transmitter Boiler #3 Supply Piping	Low flow condition to Boiler No. 3 (will be accompanied by a B301-BK alarm).	Immediately dispatch operations staff to evaluate shutdown and start standby boiler if necessary.
B400	Boiler Panel, N90 Displays 10-A, 10-E, 10-L	Boiler #4 Safety Controller	General operation and safety alarm from Boiler No. 4	Immediately dispatch operations staff to evaluate shutdown and start standby boiler if necessary.
B421-FT	BFDP-1 Indicator #12	Flow Transmitter Boiler #4 Supply Piping	Low flow condition to Boiler No. 4 (will be accompanied by a B401-BK alarm)	Immediately dispatch operations staff to evaluate shutdown and start standby boiler if necessary.
B500	N90 Display 10-L	Temperature Transmitter	Low heating water supply Temperature - Secondary	Monitor secondary supply temperature trend and firing rates of boilers in service. Dispatch operator to start additional boiler if necessary.
B600	Honeywell DDC N90 Display 7-X	BF-20 Pressure Switch	Boiler room ventilation fan has failed to run as requested, there is no air flow.	Immediately dispatch operator to digester area control room to shut system down; inspect unit to establish reason for failure, and to provide report to maintenance.

TABLE B1-2

ALARM	LOCATION	ORIGIN	CAUSE	ACTION REQUIRED
B616	Honeywell DDC N90 Display 7-X	BF-23 Pressure Switch	Boiler control room fan BF-23 has failed to run as requested, there is no air flow.	Dispatch operator immediately to open doors as necessary to hold room temperature down, request maintenance immediately.
	Honeywell DDC N90, Display 7-X	Filter Pressure Switch	Boiler control room fan BF-23 requires filter maintenance	Request maintenance
	Honeywell DDC N90, Display 7-X	Honeywell DDC	Condensing unit has failed to run as requested and second condenser has started.	Make immediate request for maintenance.
B617	Honeywell DDC N90, Display 7-X	Pressure Switch	Boiler control room has lost pressure.	Dispatch operator to make assessment.
	Honeywell DDC N90, Display 7-X	Temperature Transmitter	Boiler control room temperature is too high.	Dispatch operator to make assessment.
B660	Honewell DDC, N90, Display 7-X	Temperature Transmitter	Boiler room temperature is too high.	Monitor vent fan BF-20 through area grapyhic. If fan is running dispatch operator to establish
B907	N90 Display 10-L	Level Switch	Expansion tank level is too high or too low.	Dispatch operator to boiler room immediately to assess and correct.
B908	N90 Display 10-L	Pressure Switch	Expansion tank pressure too high or too low.	Dispatch operator to boiler room immediately to assess and correct.

A. General Operating Requirements

The central heating plant is designed to maintain the temperature of all processes and buildings at the North End Water Pollution Control Centre at normal levels during a design day in winter. Under winter design conditions and a 7-day peak flow of sludge to be heated, the calculated total facility load is 35.69 Gigagoules per hour for 1994. This estimate assumes mesophilic operation and co-thickened waste activated sludge and primary sludges.

Four boilers located in the Boiler Room as shown in Figure B201 produce the hot water required to meet the building and process heating load. Any three of the four boilers must be fired to meet the winter building and process loads projected to the year 1994. The boilers are fired as required by the plant master controller in the field device panel in order to maintain a secondary system supply water temperature of 115°C.

The boilers are controlled by the temperature of the secondary system supply water leaving the thermal storage tank. The boilers will not fire on temperatures in excess of 132°C.

Four of the boiler circulating pumps (BP-30, BP-31, BP-33 and BP-34) are dedicated to a single boiler and are intended to circulate water through one boiler only. A single standby circulating pump (BP-32) can be used for any one of the four boilers. The five boiler circulating pumps are identical. Pumping conditions differ, however for the two styles of boilers. The water-tube boilers (BH-1, BH-2, and BH-3) receive 40.5 litres per second from the pumps and the fire-tube boiler, BH-4, receives 72 litres per second. The variation is because of differences in pressure losses through the two styles of boilers.

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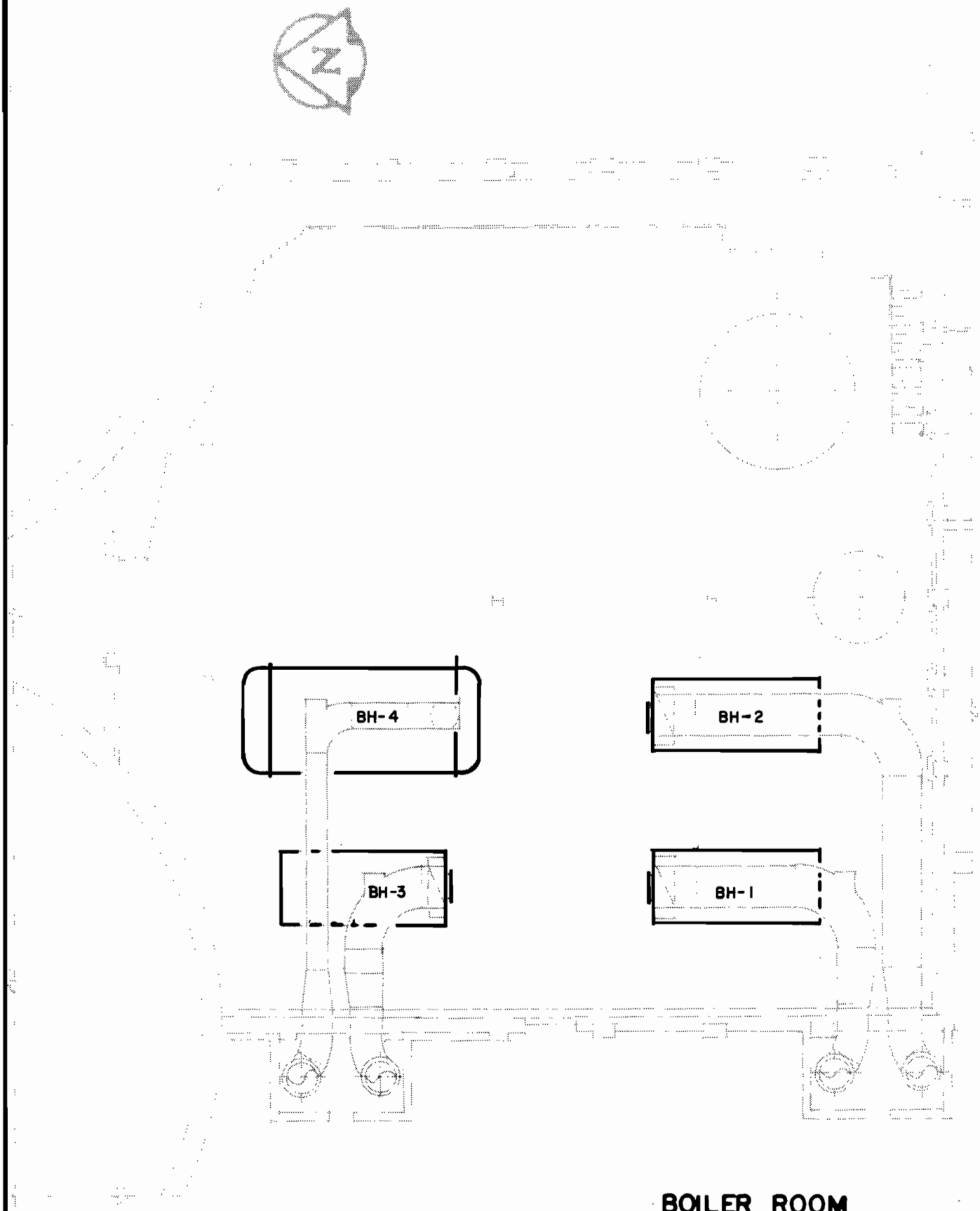


BOILER ROOM
BOILER LOCATION PLAN

fig. B201

B. Boiler Descriptions

1. Water Tube Boilers (BH-1, BH-2, and BH-3)

These boilers are custom water tube design with rear return and supply drums, manufactured by Dominion Bridge. The burners are Raskin with a Canadian Blower, Model H181-H.V.A., forced draft fan. The burner may be fueled on natural or digester gas and is equipped with a natural gas pilot system.

Boiler Design Data are:

Normal Output -	- 11.60 Gigajoules/hour
(decreased from original	- 15.8 Gigajoules/hour)
Minimum Output	- 3.16 Gigajoules
Original Design Maximum	- 19.00 Gigajoules
Waterflow Rate	- 40.5 L/S
(increased from original 31.6 L/S)	
Pressure drop through boiler	- 195 KPa
(increased from original 140 KPa)	

2. Fire Tube Boilers (BH-4)

This boiler is a horizontal four pass fire tube design with integral forced draft blower designed for firing on natural or digester gas. Boiler is a package boiler equipped with its own blend pump to ensure minimum temperature variation through the waterside chamber.

Boiler Design Data are:

Normal Output	- 17.655 Gigajoules/hour
Minimum Output	- 4.413 Gigajoules/hour
Waterflow Rate	- 72.5 L/S
Pressure Drop Through Boiler	- 9.0 KPa

C. Boiler Control

1. General

The boiler system represents the primary components of the central heating plant and accordingly, the control system associated with it is extensive. There are three levels of control, or control sequence steps applicable to the boiler operations:

a) plant firing control,

b) individual boiler firing, and

c) burner safety control.

Only plant firing control is available at BFDP-1 and the central plant control system (N90). The boiler control schematic (Fig. B202) shows the location and functional relationships of the units in the control system.

2. Plant Firing Control System

The plant firing control system enables the boilers to be operated at optimum firing efficiencies and enables temperature swings in the thermal storage tank to be minimized. The control permits boiler operation with any combination and level of modulating or fixed firing rates.

The plant firing control system ~~consists of a boiler master controller for each boiler and a plant master controller. These controllers are mounted in BFDP-1 (see Fig. B203) in the boiler area control room. A typical face plate of these controllers is shown in figure B204.~~

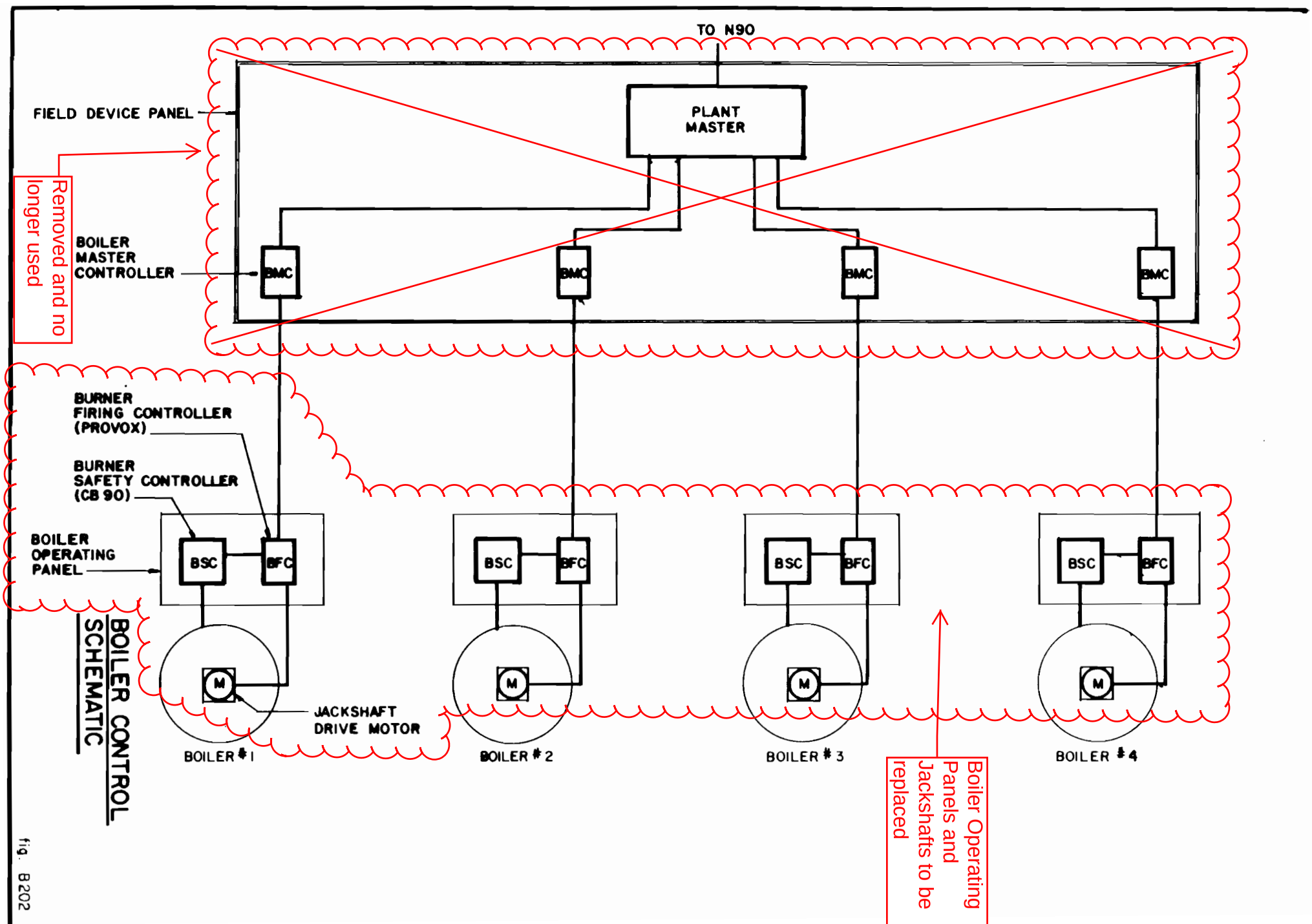
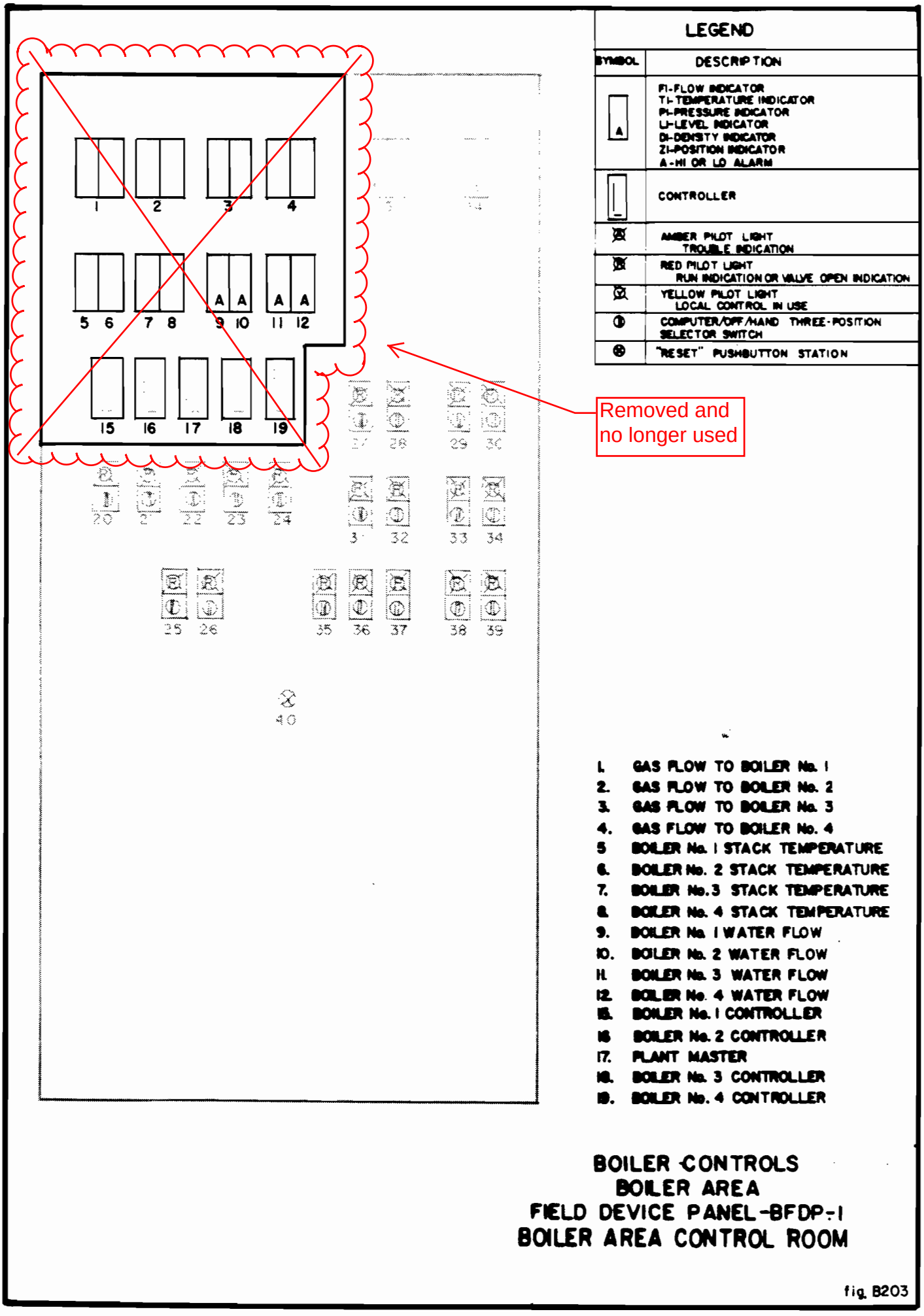
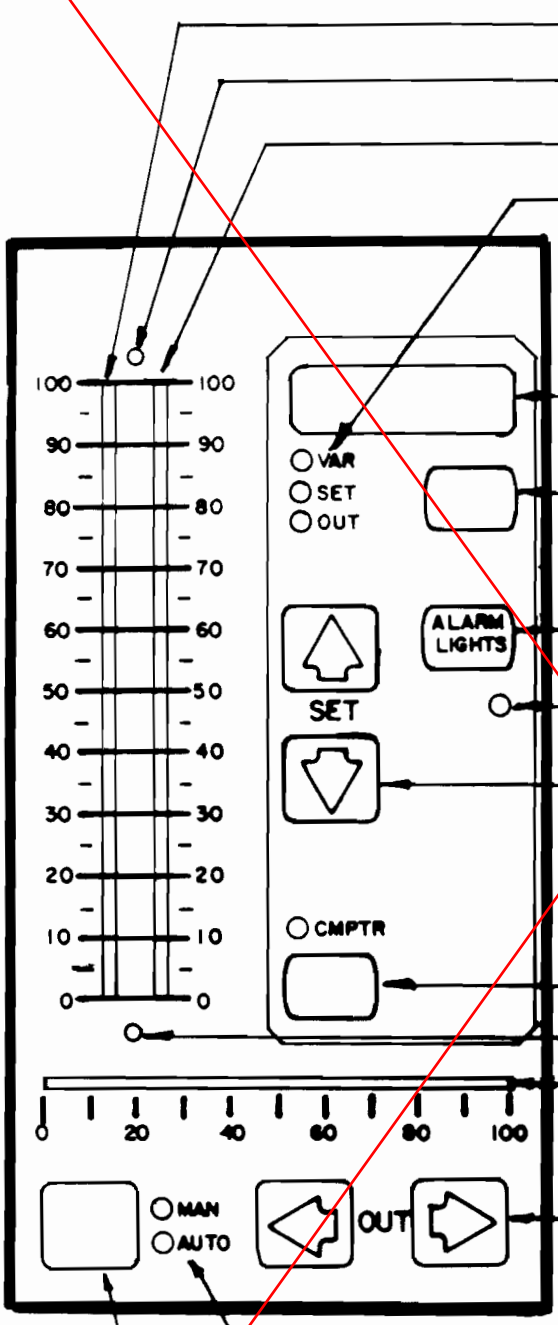

TO N90
FIELD DEVICE PANEL
PLANT MASTER
BOILER MASTER CONTROLLER
BMC
BMC
BMC
BMC
Removed and no longer used
BURNER FIRING CONTROLLER (PROVOX)
BURNER SAFETY CONTROLLER (CB 90)
BOILER OPERATING PANEL
BSC
BFC
BSC
BFC
BSC
BFC
BSC
BFC
M
M
M
M
JACKSHAFT DRIVE MOTOR
BOILER # 1
BOILER # 2
BOILER # 3
BOILER # 4
BOILER CONTROL SCHEMATIC
Boiler Operating Panels and Jackshafts to be replaced

fig. B202


LEGEND
SYMBOL
DESCRIPTION
FI-FLOW INDICATOR
TI-TEMPERATURE INDICATOR
PI-PRESSURE INDICATOR
LI-LEVEL INDICATOR
DI-DENSITY INDICATOR
ZI-POSITION INDICATOR
A-HI OR LO ALARM
CONTROLLER
AMBER PILOT LIGHT
TROUBLE INDICATION
RED PILOT LIGHT
RUN INDICATION OR VALVE OPEN INDICATION
YELLOW PILOT LIGHT
LOCAL CONTROL IN USE
COMPUTER/OFF/HAND THREE-POSITION
SELECTOR SWITCH
"RESET" PUSHBUTTON STATION
Removed and
no longer used
1. GAS FLOW TO BOILER No. 1
2. GAS FLOW TO BOILER No. 2
3. GAS FLOW TO BOILER No. 3
4. GAS FLOW TO BOILER No. 4
5 BOILER No. 1 STACK TEMPERATURE
6. BOILER No. 2 STACK TEMPERATURE
7. BOILER No. 3 STACK TEMPERATURE
8. BOILER No. 4 STACK TEMPERATURE
9. BOILER No. 1 WATER FLOW
10. BOILER No. 2 WATER FLOW
11. BOILER No. 3 WATER FLOW
12. BOILER No. 4 WATER FLOW
15. BOILER No. 1 CONTROLLER
16 BOILER No. 2 CONTROLLER
17. PLANT MASTER
18. BOILER No. 3 CONTROLLER
19. BOILER No. 4 CONTROLLER
BOILER CONTROLS
BOILER AREA
FIELD DEVICE PANEL-BFDP-1
BOILER AREA CONTROL ROOM
fig. B203



TEMP. DISPLAY

HIGH ALARM INDICATOR

TEMP SET POINT DISPLAY

DIGITAL DISPLAY SELECTION

VAR - CURRENT TEMP. °C

SET - SET POINT TEMP. °C — (115 °C - PLANT MASTER) (132 °C - BOILER MASTER)

OUT - CONTROL OUTPUT - %

DIGITAL DISPLAY

DIGITAL DISPLAY BUTTON

DEPRESS TO SELECT DISPLAY

ALARM LIMIT BUTTON

DEPRESS TO READ DISPLAY

ALARM INDICATOR

SLEW BUTTONS - SET POINT

DEPRESS ▽ TO MOVE SET POINT DOWN

DEPRESS △ TO MOVE SET POINT UP

CONTROLLER MUST BE IN AUTO MODE TO CHANGE

NON OPERATIVE

LOW ALARM INDICATOR

DRIVE POSITION DISPLAY - %

SLEW BUTTONS - DRIVE POSITION

DEPRESS ◁ TO MOVE POSITION DOWN

DEPRESS ▷ TO MOVE POSITION UP

CONTROLLER MUST BE IN MAN. MODE TO CHANGE

MANUAL OR AUTO. INDICATORS

MANUAL/AUTO SELECTOR BUTTON

BOILER MASTER

(PLANT MASTER IDENTICAL)

fig. B204

3. Boiler Firing Controller

The firing controller provides operating personnel with control of firing at the boiler. The firing controller communicates with the central N90 control system through the boiler and plant master controllers.

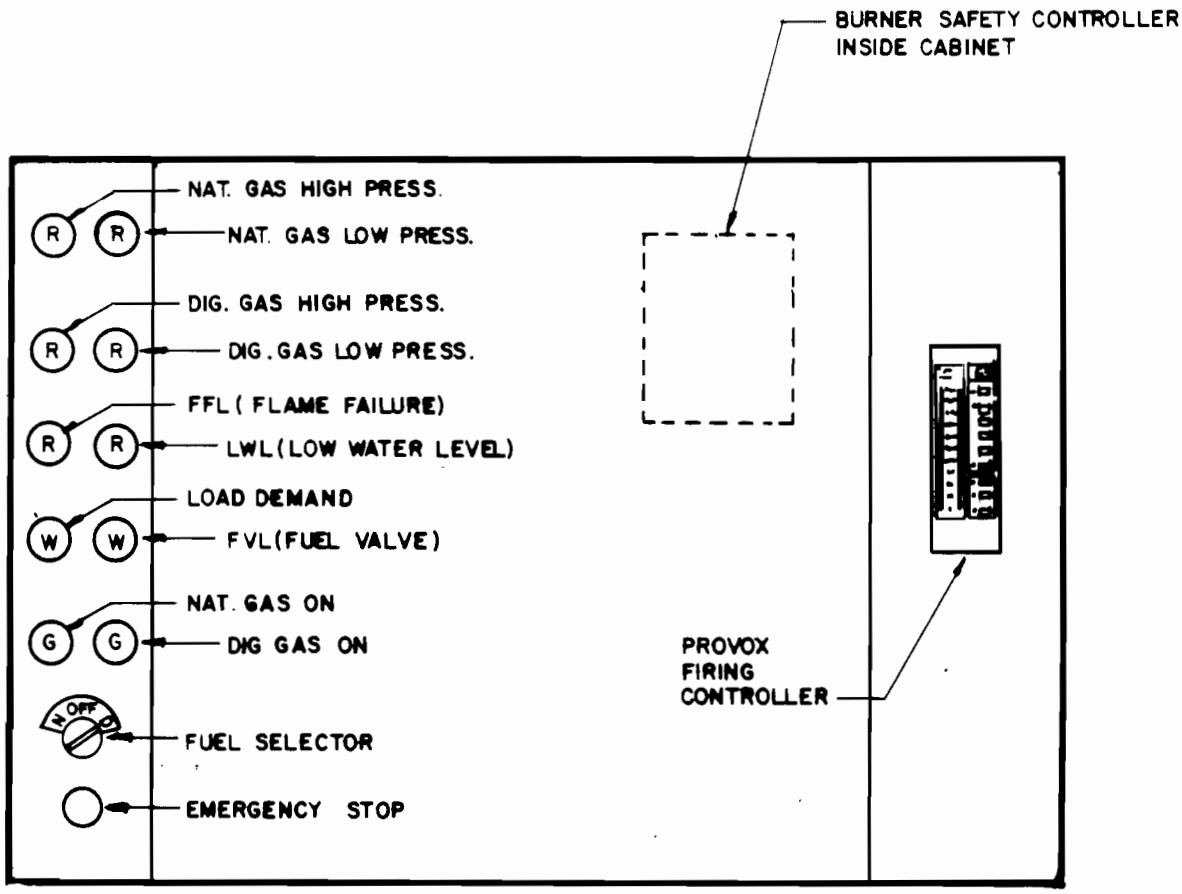
The burner firing controller is mounted on the front of the boiler operating panel as shown in figures B205 & B206. The face plate of the firing controller (Fisher Provox computing controller) is shown in figure B207. Once the burner safety controller has completed all its safety checks and has ignited the burner on low fire, the firing controller assumes control of the burner.

Foxboro

The firing controller has three operating modes: manual, automatic and DCC (remote)

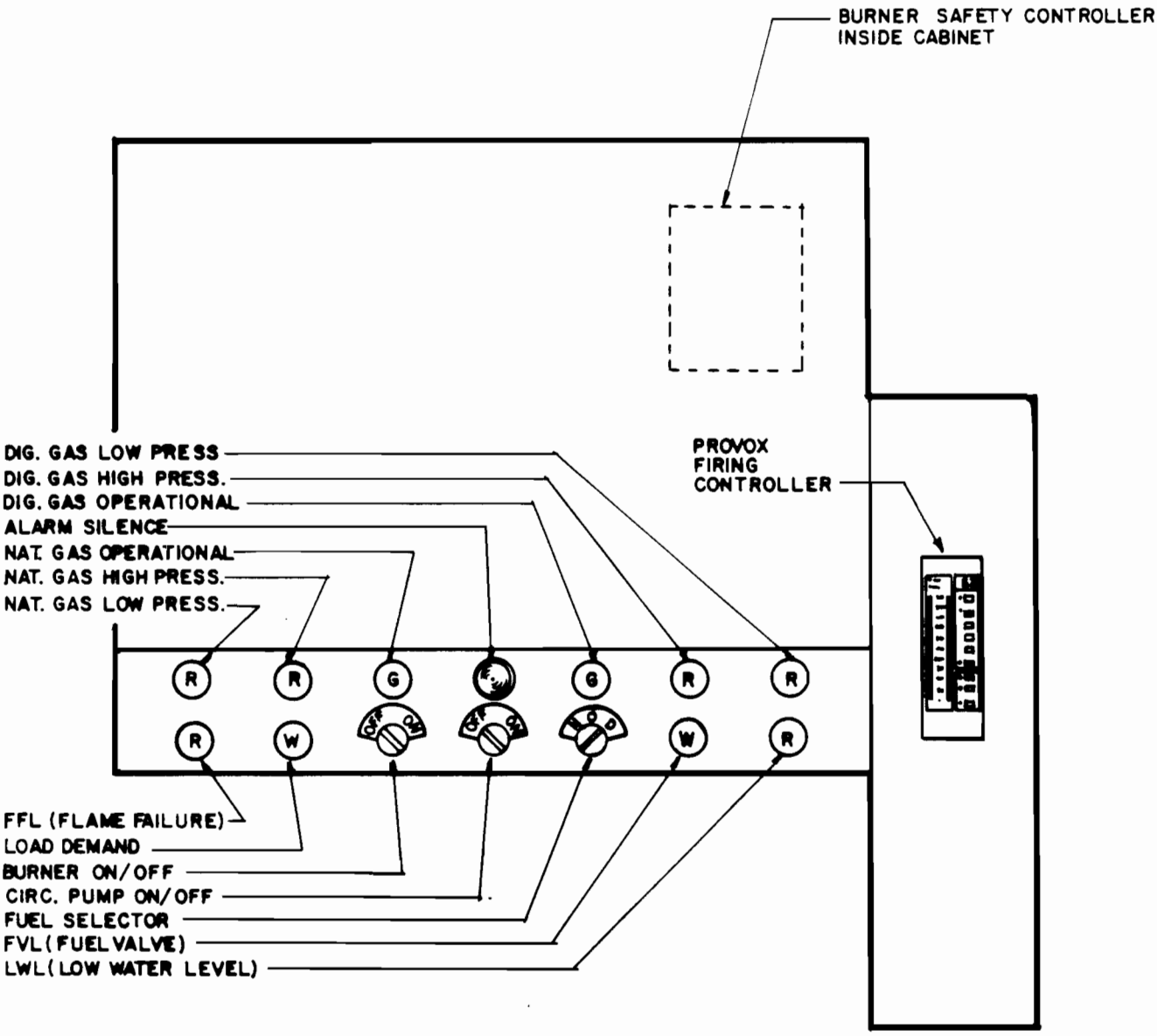
3.1 Manual Operation

In the manual mode, operating personnel are able to manually control the firing of the boiler and adjust the setpoint. This mode is used when bringing a new boiler on line. By using the setpoint key and slew keys the set point can be changed. By using the output key and slew keys, the output signal to the modulating motor on the jack shaft assembly can be controlled. These controls enable operating personnel to manually take the burner from minimum fire to the firing rate necessary to satisfy setpoint before transferring to automatic control. When the output signal is being adjusted, the firing rate in percentage is shown on the numeric display. The firing rate cannot be reduced to zero because of minimum firing rate requirements on the burners. The minimum rate on the three water-tube boilers is 21% and the minimum firing rate on the fire-tube boiler is 30%. The firing rate displayed by the controller represents the drive signal to the motor. Minimum fire rate display consequently is somewhat less than the actual minimum firing rate to ensure the shaft drive motor is held at minimum position.



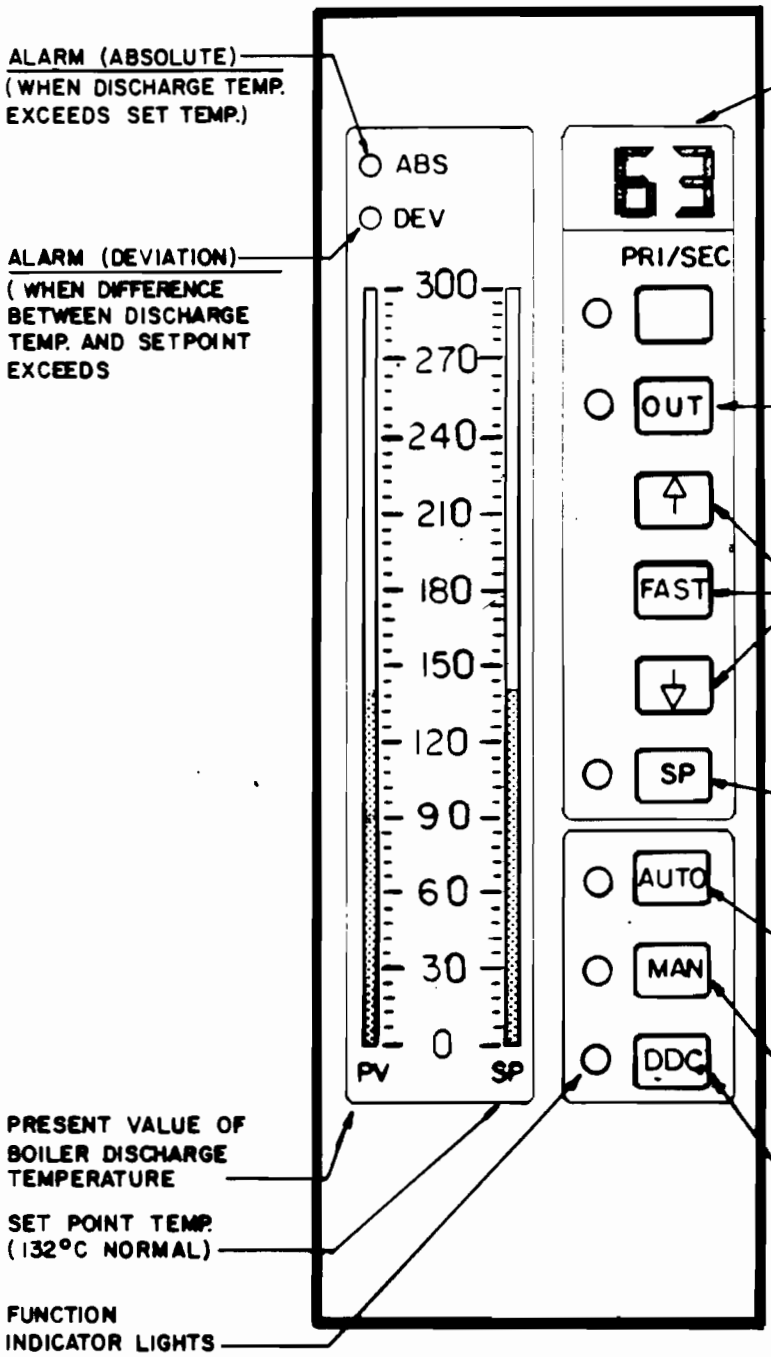
BOILER OPERATING PANEL-BOILERS No.1,2 & 3

fig. B205



BOILER OPERATING PANEL-BOILER No. 4

fig. B206



ALARM (ABSOLUTE)
(WHEN DISCHARGE TEMP. EXCEEDS SET TEMP.)

ALARM (DEVIATION)
(WHEN DIFFERENCE BETWEEN DISCHARGE TEMP. AND SETPOINT EXCEEDS

PRESENT VALUE OF BOILER DISCHARGE TEMPERATURE

SET POINT TEMP. (132°C NORMAL)

FUNCTION INDICATOR LIGHTS

DIGITAL DISPLAY

DISPLAYS - ERROR CODES - DISPLAYED AUTOMATICALLY
- PRESENT VALUE °C - CONT.
- SET POINT °C - DEPRESS SP
- OUTPUT % (SIGNAL TO FUELING DRIVE) - DEPRESS OUT

OUTPUT

DEPRESS TO READ OUTPUT SIGNAL, OR TO CHANGE FIRE RATE WITH SLEW BUTTONS IN MANUAL MODE

SLEW BUTTONS

USED TO CHANGE OUTPUT OR SETPOINT (DEPRESS ▽ OR FAST ▽ TO MOVE OUTPUT OR SETPOINT DOWN
DEPRESS △ ONLY TO MOVE UP, NEVER PRESS FAST/△

SETPOINT

DEPRESS TO READ SETPOINT OR TO CHANGE SETPOINT WITH SLEW BUTTONS IN MANUAL OR AUTO MODES

AUTO

DEPRESS TO PLACE PROVOX IN AUTO CONTROL FROM BOILER DISCHARGE TEMP.

MANUAL

DEPRESS TO OBTAIN MANUAL CONTROL OF BOILER FIRING RATE

DDC (DIRECT DIGITAL CONTROL

DEPRESS TO RELEASE CONTROL OF BOILER TO CENTRAL COMPUTER CONTROL

Note: Provox Firing controllers have been replaced with Foxboro controllers

PROVOX FIRING CONTROL

fig B207

3.2 Automatic Operation

The "auto" mode enables the controller to fire the boiler at whatever rate is required to maintain the setpoint temperature. The setpoint temperature (SP) and present value of the discharge temperature (PV) are continuously displayed on the bar display in celcius degrees.

3.3 DCC (Remote Operation)

Once the boiler has stabilized and is firing at a controlled rate on the [auto] setting, control of boiler firing can be transferred to central computer control by depressing the [DDC] pushbutton. Provided the central computer system is operational, the transfer will take place, otherwise control of the boiler will be returned to the burning firing controller (Provox) and operation will be maintained in the [auto] mode.

The numeric display window displays error codes whenever an internal or external malfunction of the computer or connected devices occurs. An instrumentation technician is to be advised immediately in the event an error code is displayed.

The firing controller has a resident program that is entered and adjusted from a portable keypad. This keypad and the initial program on a magnetic card are in the possession of the senior process personnel.

4. Burner Safety Controller

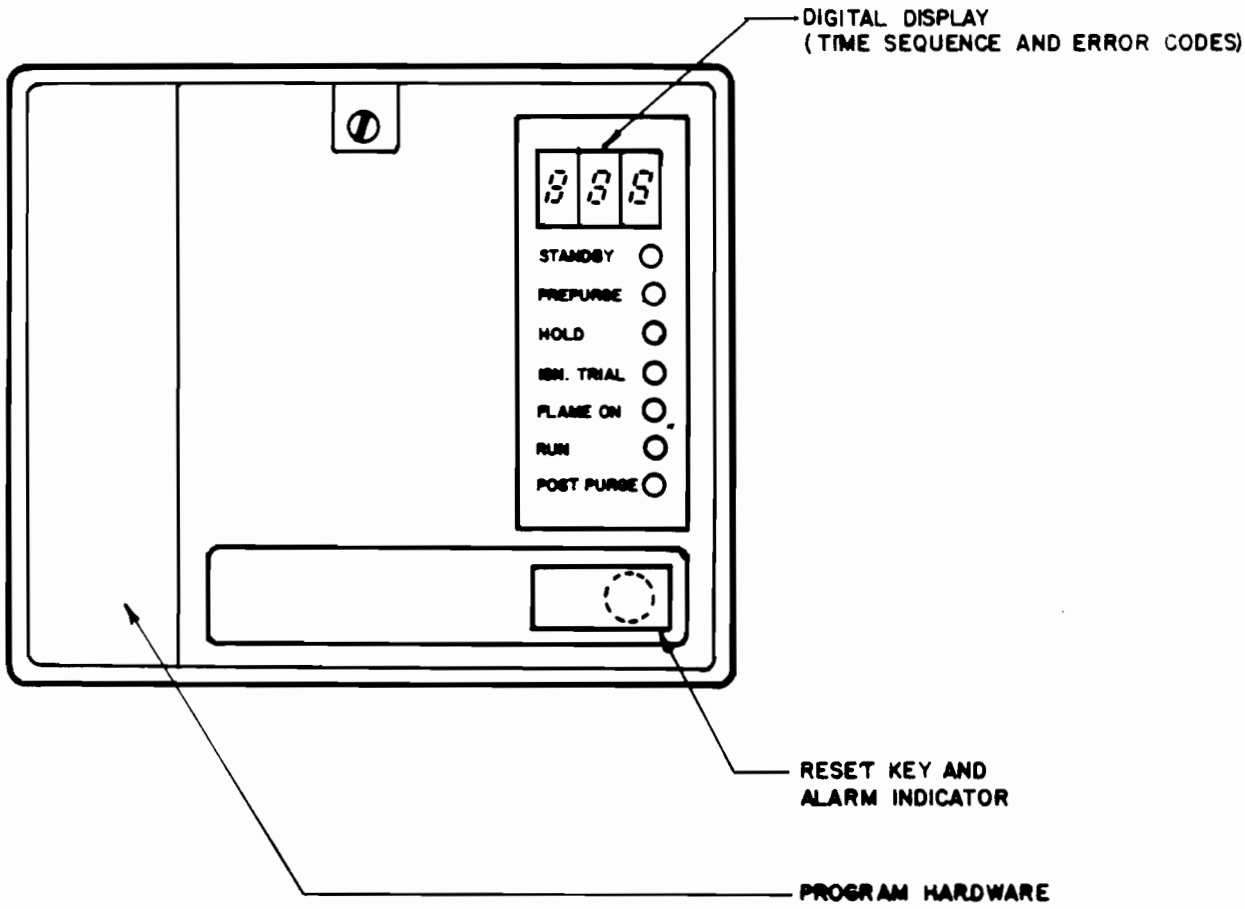
The burner safety controller supervises the start-up of the burner (see Fig. B209) and continues to monitor all safety devices throughout the burn cycle. The safety controls provide flame supervision, status indication, failure annunciation and self-diagnostic procedures. Only when this controller has completed the successful startup of a burner, can the boiler be released to the next level of control, the burner firing controller. The burner safety controller does receive input from an operating limit temperature control but it is not the burner operating control.

The burner safety controller, Fig. B 208, is located inside the boiler operating panel as shown in figures B205 & B206.

The safety controller is programmed to continually check all the safety routines involved with the boiler operation. It immediately executes a burner shutdown if any of the following occurs:

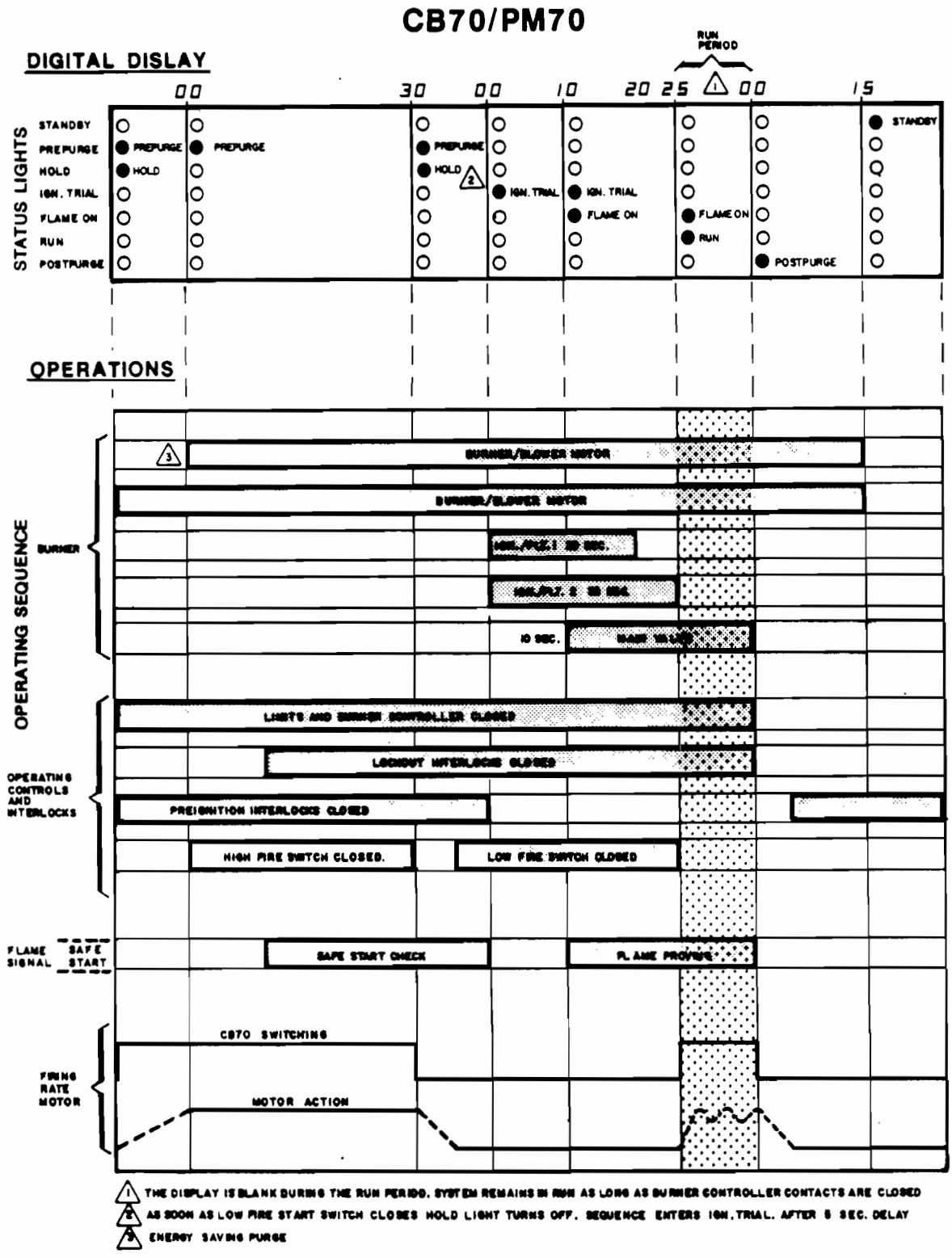
1) A flame signal is present during standby.
2) A preignition interlock opens during standby.
3) The low fire start switch fails to close when the firing rate motor is commanded toward the low fire position at the end of prepurge.
4) The pilot fails to ignite.
5) The main flame fails to ignite when requested.
6) Intermittent signals (contact failure) from limits and controllers.
7) Supply power frequency deviation.
8) Program Module malfunctions.
9) An internal failure of the CB70.
10) A flame detection system failure.
11) Flame signal detected during prepurge.
12) The high fire purge switch fails to close after the firing rate motor is commanded to drive to the high fire position at the start of prepurge.
13) A preignition interlock opens during the prepurge period.
14) Flame signal is detected during low fire hold.
15) Any safety device opens during the prepurge ignition trial, or during run periods.
16) A preignition interlock opens during postpurge.
17) The low fire proving switch opens during trial for main flame.

When a safety shutdown (lockout) occurs, a fault code is displayed, an alarm signal is generated, and the reset switch is illuminated. A list of failure signals is provided in Table B2.1.



BURNER SAFETY
CONTROLLER

fig. B208



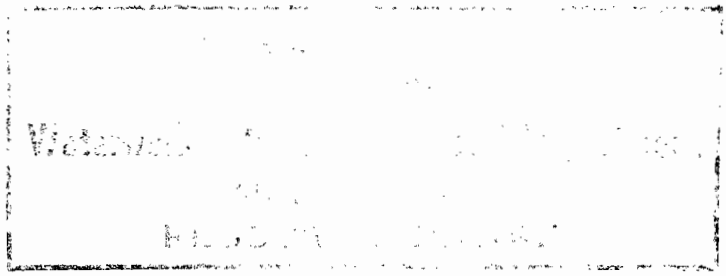
SAFETY CONTROLLER - OPERATING SEQENCE

SAFETY CONTROLLER - OPERATING SEQUENCE

fig. B209

Table B2.1
BURNER SAFETY CONTROL
ERROR CODES

F-00 - Flame signal during prepurge
F-01 - High fire purge switch fails to close during prepurge
F-03 - Preignition interlock opens during prepurge
F-04 - Safety device opens
F-10 - Flame signal during a low fire hold
F-11 - Low fire start switch fails to close at end of prepurge
F-14 - Safety device opens
F-30 - Pilot fails to ignite
F-34 - Safety device opens
F-40 - Main flame fails to ignite
F-41 - Low fire proving switch opens during main flame trial
F-44 - Safety device opens
F-54 - Safety device opens
F-63 - Preignition interlock opens during post purge
F-70 - Flame signal during standby
F-73 - Preignition interlock opens during standby
F-81 - Signal interruptions from limit and control devices
F-82 - Signal interruptions from limit and control devices
F-83 - Signal interruptions from limit and control devices
F-84 - Signal interruptions from limit and control devices
F-85 - Signal interruptions from limit and control devices
F-86 - Signal interruptions from limit and control devices
F-87 - Signal interruptions from limit and control devices
F-90 - Failure of program module
F-97 - Power emergency deviation
F-99 - Internal failure of CB70 or flame detection system



5. Control Summary

Monitoring and control devices for the boilers are provided within each system and these are listed for each of the four boilers in the equipment/instrument summaries (Tables B2-2 to B2-5). Monitoring, control and alarm indication associated with each device are provided at various panels and locations within the control system. The nature of the indication and control provided at the various levels in the control hierarchy are also shown in these summary tables.

D. Auxiliaries

1. Fuel Systems

The boilers can be fired on either utility natural gas or digester gas. The selection of fuel supply is made at the control panel for each boiler. (See Fig. B205 & Fig. B206)

Utility fuel is provided as standby to the primary digester gas fuel supply and normally would be used only when there was insufficient digester gas.

Digester gas availability is monitored at the Field Device Panel in the digester control room.

Fueling of the burners is controlled by manually adjustable cams that drive the fuel and combustion air flow control equipment (butterfly valves on the fuel gas supplies and dampers on the combustion air). The adjustable ratio provided by these cams enables calibration of the burner to optimum fuel/air ratios throughout the entire firing range. Periodic boiler flue gas checks are necessary to confirm optimum ratio settings.

Normal gas flows at maximum firing rates for the boilers are:

BOILER NO. 1

INSTRUMENT TAG NUMBER	SERVICE	ON LINE	LOCAL BOILER OPER. PANEL	FDP (HAND)	BAILEY N90 REMOTE SUPERVISION	REMARKS NORMAL SETPOINT/RANGE
PUMPING						
B100-HS -A	BOILER 1 CIRC. PUMP BP31 C/O/H	-	-	IC	IC	
B100-HS -B	BOILER 1 CIRC. PUMP BP31 L/O/S	S	-	-	-	
B100-PG -A	BOILER PUMP BP31 DISCHARGE	I	-	-	-	620 +/- 35 L/S
B100-PG -B	BOILER PUMP BP31 SUCTION	I	-	-	-	460 +/- 35 L/S
FIRE CONTROL AND MONITORING						
--	BURNER SAFETY CONTROLLER	-	IAS	-	-	
B101-BK	BURNER FIRING CONTROLLER	-	ICAS	-	I	HI FIRE, FIRE ENBL, MAN STS LOCKOUT, COM. ALM, FN RN, FIRE POS.
B101-TIC	BOILER MASTER	-	-	IC	ICA	CONTROL FROM PLANT MASTER (B500-T16)
B101-TT	BOILER 1 WATER EXIT TEMP.	I	IC	IC	I	110 TO 132 °C
B101-TV	JACKSHAFT ACTUATOR	-	IC	-	-	TO 100%
B101-TSH	BOILER 1 HIGH EXIT WATER TEMP.	R	-	-	-	137°C
B102-TI	BOILER 1 FLUE GAS TEMP.	-	-	I	I	170 TO 210 °C
FUEL SYSTEMS						
B104-FT	NAT. GAS FLOW TO BLR. 1	I	-	-	-	
B104-FI	NAT. GAS FLOW TO BLR. 1	-	-	I	I	85 TO 400 M3/HR
B105-FT	SLUDGE GAS FLOW TO BLR. 1	I	-	-	-	
B105-FI	SLUDGE GAS FLOW TO BLR. 1	-	-	I	I	130 TO 620 M3/HR
B106-PCV -A	BURNER NAT. GAS PRESS. REGULATOR	-	-	-	-	35 kPa TO 18 kPa
B106-PCV -B	PILOT NAT. GAS PRESS. REGULATOR	-	-	-	-	
B107-PCV	SLUDGE GAS PRESS. REGULATOR	-	-	-	-	120 KPa TO 18 KPa
B110-HV -A	NAT. GAS TO BLR. 1 SHUT-OFF VALVE	I	IC	-	-	
B110-HV -B	NAT. GAS TO BLR. 1 SHUT-OFF VALVE	I	IC	-	-	
B110-HV -C	NAT. GAS TO BLR. 1 BLEED VALVE	-	C	-	-	
B111-HV -A	SLUDGE GAS TO BLR. 1 SHUT-OFF VALVE	I	IC	-	-	
B111-HV -B	SLUDGE GAS TO BLR. 1 SHUT-OFF VALVE	I	IC	-	-	
B111-HV -C	SLUDGE GAS TO BLR. 1 BLEED VALVE	-	C	-	-	
B112-HV	PILOT GAS SUPPLY SHUT OFF	-	-	-	-	
B113-PSH	SLUDGE GAS HIGH PRESS. TRIP	R	IA	-	-	48 KPa
B114-PSH	NAT. GAS HIGH PRESS. TRIP	R	IA	-	-	43 KPa
B115-PSL	SLUDGE GAS LOW PRESS. TRIP	R	IA	-	-	28 KPa
B116-PSL	NAT. GAS LOW PRESS. TRIP	R	IA	-	-	.5 KPa
SAFETY CONTROLS						
B117-PSL	LOW WINDBOX PRESS.	-	IA	-	-	
B118-LSL	BOILER NO. 1 LOW WATER LEVEL	-	IA	-	-	
B119-BD	BURNER FLAME SCANNER	-	IA	-	-	
PRODUCTION MONITORING						
B121-FT	WATER FLOW	I	-	-	-	
B121-FI	WATER FLOW INDICATOR	-	-	IAR	IA	39 +/- 3 L/S - USED WITH TEMP. DIF. TO CALC. PROD.

S - SAFETY STOP A - ALARM C - CONTROL I - INDICATION R - RESET

01-Jan-80 * * * EQUIPMENT/INSTRUMENT SUMMARY * * * TABLE B2-3

TABLE B2-3

BOILER NO. 2

INSTRUMENT TAG NUMBER	SERVICE	LOCAL ON LINE	BOILER OPER. PANEL	FDP (HAND)	BAILEY N90 REMOTE SUPERVISION	REMARKS NORMAL SETPOINT/RANGE
PUMPING						
B200-HS -A	BOILER 1 CIRC. PUMP BP31 C/O/H	-	-	IC	IC	
B200-HS -B	BOILER 1 CIRC. PUMP BP31 L/O/S	S	-	-	-	
B200-PG -A	BOILER PUMP BP31 DISCHARGE	I	-	-	-	620 +/- 35 L/S
B200-PG -B	BOILER PUMP BP31 SUCTION	I	-	-	-	460 +/- 35 L/S
FIRE CONTROL AND MONITORING						
--	BURNER SAFETY CONTROLLER	-	IAS	-	-	
B201-BK	BURNER FIRING CONTROLLER	-	ICAS	-	I	HI FIRE, FIRE ENBL, MAN STS LOCKOUT, COM. ALM, FN RN, FIRE POS.
B201-TIC	BOILER MASTER	-	-	IC	ICA	
B201-TT	BOILER 1 WATER EXIT TEMP.	I	IC	IC	I	110 TO 132 °C
B201-TV	JACKSHAFT ACTUATOR	-	IC	-	-	TO 100%
B201-TSH	BOILER 1 HIGH EXIT WATER TEMP.	R	-	-	-	137°C
B202-TI	BOILER 1 FLUE GAS TEMP.	-	-	I	I	170 TO 210 °C
FUEL SYSTEMS						
B204-FT	NAT. GAS FLOW TO BLR. 1	I	-	-	-	
B204-FI	NAT. GAS FLOW TO BLR. 1	-	-	I	I	85 TO 400 M3/HR
B205-FT	SLUDGE GAS FLOW TO BLR. 1	I	-	-	-	
B205-FI	SLUDGE GAS FLOW TO BLR. 1	-	-	I	I	130 TO 620 M3/HR
B206-PCV -A	BURNER NAT. GAS PRESS. REGULATOR	-	-	-	-	35 kPa TO 18 kPa
B206-PCV -B	PILOT NAT. GAS PRESS. REGULATOR	-	-	-	-	
B207-PCV	SLUDGE GAS PRESS. REGULATOR	-	-	-	-	120 KPa TO 18 KPa
B210-HV -A	NAT. GAS TO BLR. 1 SHUT-OFF VALVE	I	IC	-	-	
B210-HV -B	NAT. GAS TO BLR. 1 SHUT-OFF VALVE	I	IC	-	-	
B210-HV -C	NAT. GAS TO BLR. 1 BLEED VALVE	-	C	-	-	
B211-HV -A	SLUDGE GAS TO BLR. 1 SHUT-OFF VALVE	I	IC	-	-	
B211-HV -B	SLUDGE GAS TO BLR. 1 SHUT-OFF VALVE	I	IC	-	-	
B211-HV -C	SLUDGE GAS TO BLR. 1 BLEED VALVE	-	C	-	-	
B212-HV	PILOT GAS SUPPLY SHUT OFF	-	-	-	-	
B213-PSH	SLUDGE GAS HIGH PRESS. TRIP	R	IA	-	-	48
B214-PSH	NAT. GAS HIGH PRESS. TRIP	R	IA	-	-	43
B215-PSL	SLUDGE GAS LOW PRESS. TRIP	R	IA	-	-	28
B216-PSL	NAT. GAS LOW PRESS. TRIP	R	IA	-	-	.5
SAFETY CONTROLS						
B217-PSL	LOW WINDBOX PRESS.	-	IA	-	-	
B218-LSL	BOILER NO. 1 LOW WATER LEVEL	-	IA	-	-	
B219-BD	BURNER FLAME SCANNER	-	IA	-	-	
PRODUCTION MONITORING						
B221-FT	WATER FLOW	I	-	-	-	
B221-FI	WATER FLOW INDICATOR	-	-	IAR	IA	39 +/- 3 L/S - USED WITH TEMP. DIF. TO CALC. PROD.

S - SAFETY STOP A - ALARM C - CONTROL I - INDICATION R - RESET

01-Jan-80 * * *EQUIPMENT/INSTRUMENT SUMMARY * * * TABLE B2-4 1

TABLE B2-4

BOILER NO. 3

INSTRUMENT TAG NUMBER	SERVICE	ON LINE	LOCAL BOILER OPER. PANEL	FDP (HAND)	BAILEY N90 REMOTE SUPERVISION	REMARKS NORMAL SETPOINT/RANGE
PUMPING						
B300-HS -A	BOILER 1 CIRC. PUMP BP31 C/O/H	-	-	IC	IC	
B300-HS -B	BOILER 1 CIRC. PUMP BP31 L/O/S	S	-	-	-	
B300-PG -A	BOILER PUMP BP31 DISCHARGE	I	-	-	-	620 +/- 35 L/S
B300-PG -B	BOILER PUMP BP31 SUCTION	I	-	-	-	460 +/- 35 L/S
FIRE CONTROL AND MONITORING						
--	BURNER SAFETY CONTROLLER	-	IAS	-	-	
B301-BK	BURNER FIRING CONTROLLER	-	ICAS	-	I	HI FIRE, FIRE ENBL, MAN STS LOCKOUT, COM. ALM, FN RN, FIRE POS.
B301-TIC	BOILER MASTER	-	-	IC	ICA	
B301-TT	BOILER 1 WATER EXIT TEMP.	I	IC	IC	I	110 TO 132 °C
B301-TV	JACKSHAFT ACTUATOR	-	IC	-	-	TO 100%
B301-TSH	BOILER 1 HIGH EXIT WATER TEMP.	R	-	-	-	137°C
B302-TI	BOILER 1 FLUE GAS TEMP.	-	-	I	I	170 TO 210 °C
FUEL SYSTEMS						
B304-FT	NAT. GAS FLOW TO BLR. 1	I	-	-	-	
B304-FI	NAT. GAS FLOW TO BLR. 1	-	-	I	I	85 TO 400 M3/HR
B305-FT	SLUDGE GAS FLOW TO BLR. 1	I	-	-	-	
B305-FI	SLUDGE GAS FLOW TO BLR. 1	-	-	I	I	130 TO 620 M3/HR
B306-PCV -A	BURNER NAT. GAS PRESS. REGULATOR	-	-	-	-	35 kPa TO 18 kPa
B306-PCV -B	PILOT NAT. GAS PRESS. REGULATOR	-	-	-	-	
B307-PCV	SLUDGE GAS PRESS. REGULATOR	-	-	-	-	120 KPa TO 18 KPa
B310-HV -A	NAT. GAS TO BLR. 1 SHUT-OFF VALVE	I	IC	-	-	
B310-HV -B	NAT. GAS TO BLR. 1 SHUT-OFF VALVE	I	IC	-	-	
B310-HV -C	NAT. GAS TO BLR. 1 BLEED VALVE	-	C	-	-	
B311-HV -A	SLUDGE GAS TO BLR. 1 SHUT-OFF VALVE	I	IC	-	-	
B311-HV -B	SLUDGE GAS TO BLR. 1 SHUT-OFF VALVE	I	IC	-	-	
B311-HV -C	SLUDGE GAS TO BLR. 1 BLEED VALVE	-	C	-	-	
B312-HV	PILOT GAS SUPPLY SHUT OFF	-	-	-	-	
B313-PSH	SLUDGE GAS HIGH PRESS. TRIP	R	IA	-	-	48
B314-PSH	NAT. GAS HIGH PRESS. TRIP	R	IA	-	-	43
B315-PSL	SLUDGE GAS LOW PRESS. TRIP	R	IA	-	-	28
B316-PSL	NAT. GAS LOW PRESS. TRIP	R	IA	-	-	.5
SAFETY CONTROLS						
B317-PSL	LOW WINDBOX PRESS.	-	IA	-	-	
B318-LSL	BOILER NO. 1 LOW WATER LEVEL	-	IA	-	-	
B319-BD	BURNER FLAME SCANNER	-	IA	-	-	
PRODUCTION MONITORING						
B321-FT	WATER FLOW	I	-	-	-	
B321-FI	WATER FLOW INDICATOR	-	-	IAR	IA	39 +/- 3 L/S - USED WITH TEMP. DIF. TO CALC. PROD.

S - SAFETY STOP A - ALARM C - CONTROL I - INDICATION R - RESET

01-Jan-80 * * * EQUIPMENT/INSTRUMENT SUMMARY * * * TABLE B2-5 1

TABLE B2-5

BOILER NO. 4

INSTRUMENT TAG NUMBER	SERVICE	ON LINE	LOCAL BOILER OPER. PANEL	FDP (HAND)	BAILEY N90 REMOTE SUPERVISION	REMARKS NORMAL SETPOINT/RANGE
PUMPING						
B400-HS -A	BOILER 4 CIRC. PUMP C/O/H	-	-	IC	IC	-
B400-HS -B	BOILER 4 CIRC. PUMP L/O/S	S	-	-	-	
B400-PG -A	BOILER PUMP BP34 DISCHARGE	I	-	-	-	510 kPa +/- 35 L/S
B400-PG -B	BOILER PUMP BP34 SUCTION	I	-	-	-	420 kPa +/- 35 L/S
FIRE CONTROL AND MONITORING						
--	BURNER SAFETY CONTROLLER	-	IAS	-	-	
B401-BK	BURNER FIRING CONTROLLER	-	ICAS	-	I	HI FIRE, FIRE ENBL MAN STS LOCKOUT, COM. ALM, AN STS, FIRE POS.
B401-TIC	BOILER 4 MASTER	-	-	IC	ICA	
B401-TSH	BOILER 4 HIGH EXIT WATER TEMP.	R	-	-	-	137°C
B401-TT	BOILER 4 WATER EXIT TEMP.	I	IC	IC	I	110°C TO 132°C
B401-TV	JACKSHAFT ACTUATOR	-	IC	-	-	20 TO 100%
B402-TI	BOILER 4 FLUE GAS TEMP.	-	-	I	I	170 TO 210°C
FUEL SYSTEMS						
B404-FT	NAT. GAS FLOW TO BOILER 4	I	-	-	-	
B404-FI	NAT. GAS FLOW TO BOILER 4	-	-	I	I	TO 625 M3/HR
B405-FT	SLUDGE GAS FLOW TO BOILER 4	I	-	-	-	
B405-FI	SLUDGE GAS FLOW TO BOILER 4	-	-	I	I	TO 960 M3/HR
B406-PCV -A	BURNER NAT. GAS PRESS. REGULATOR	-	-	-	-	35 kPa TO
B406-PCV -B	PILOT NAT. GAS PRESS. REGULATOR	-	-	-	-	
B407-PCV	SLUDGE GAS PRESS. REGULATOR	-	-	-	-	120 kPa TO
B410-HV -A	NAT. GAS TO BOILER 4 SHUT-OFF VALVE	I	IC	-	-	
B410-HV -B	NAT. GAS TO BOILER 4 SHUT-OFF VALVE	I	IC	-	-	
B410-HV -C	NAT. GAS TO BOILER 4 BLEED VALVE	-	C	-	-	
B411-HV -A	SLUDGE GAS TO BOILER 4 SHUT-OFF VALVE	I	IC	-	-	
B411-HV -B	SLUDGE GAS TO BOILER 4 SHUT-OFF VALVE	I	IC	-	-	
B411-HV -C	SLUDGE GAS TO BOILER 4 BLEED VALVE	-	C	-	-	
B412-HV	PILOT GAS SUPPLY SHUT-OFF	-	-	-	-	
B413-PSH	SLUDGE GAS HIGH PRESS. TRIP	R	IA	-	-	
B414-PSH	NAT. GAS HIGH PRESS. TRIP	R	IA	-	-	
B415-PSL	SLUDGE GAS LOW PRESS. TRIP	R	IA	-	-	
B416-PSL	NAT. GAS LOW PRESS. TRIP	R	IA	-	-	
SAFETY CONTROLS						
B417-PSL	LOW WINDBOX PRESS.	--	IA	-	-	
B418-LSL	BOILER 4 LOW WATER LEVEL	--	IA	-	-	
B419-BD	BURNER FLAME SCANNER	-	IA	-	-	
PRODUCTION MONITORING						
B421-FT	WATER FLOW	I	-	-	-	
B421-FI	WATER FLOW INDICATOR	-	-	IAR	IA	70 +/- 5 L/S - USED WITH TEMP. DIF. TO CALC. PROD.

S - SAFETY STOP A - ALARM C - CONTROL I - INDICATION R - RESET

BH-1, BH-2, BH-3	- natural gas	- 389 m^3/hr.
(water tube)	- digester gas	- 598 m^3/hr.
BH-4	- natural gas	- 594 m^3/hr.
(fire tube)	- digester gas	- 913 m^3/hr.

Natural Gas

Natural gas is supplied to the building from the utility regulator at 35 KPa. This pressure is reduced at each boiler to 17 KPa pressure. Natural gas consumption is metered at the service entry in the south east corner of the boiler room. The natural gas fuel train is shown in Figure B210.

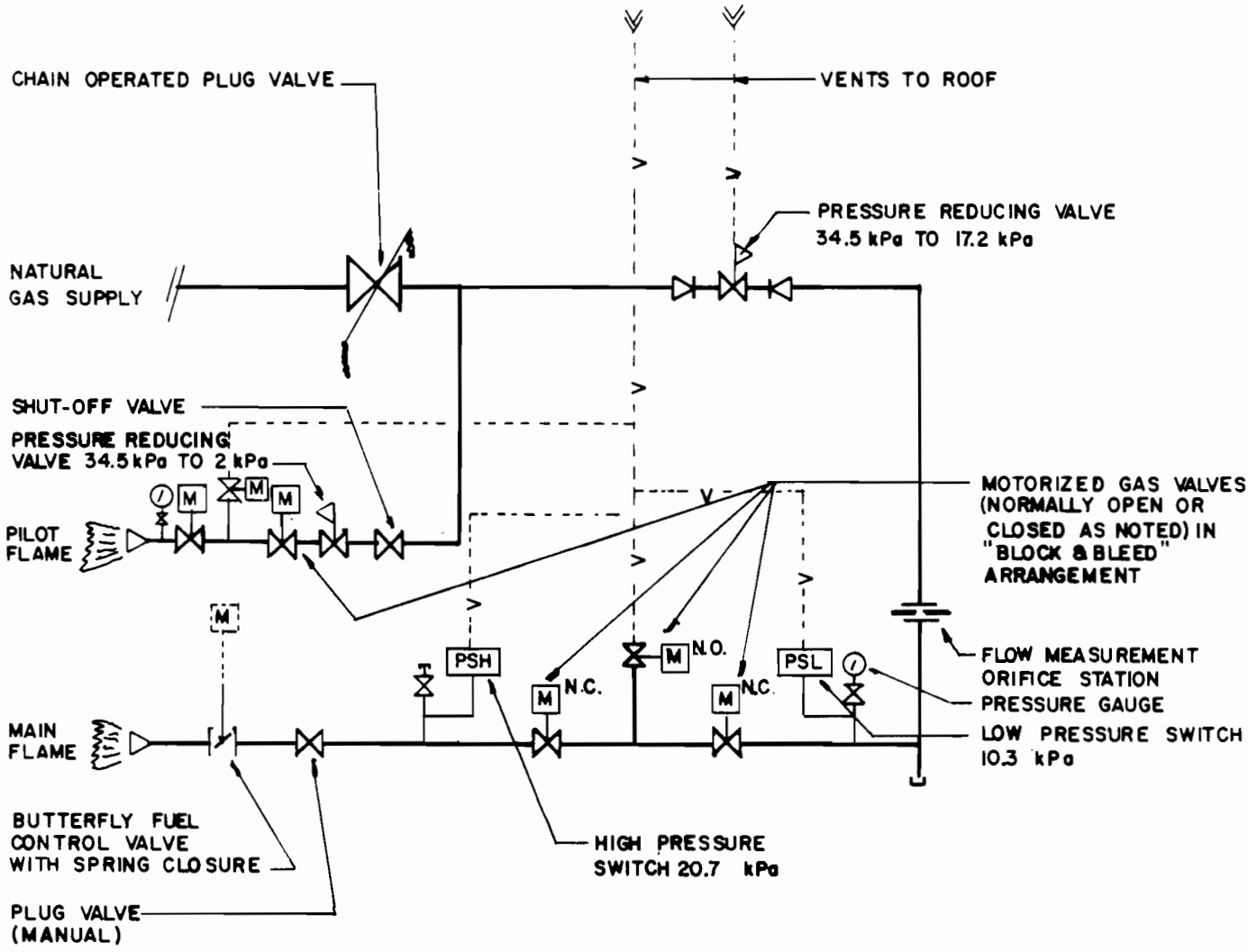
Digester Gas

Digester or sludge gas is supplied from the gas sphere and gas booster compressors in digester galleries number 5 and 7 through a 150 mm supply main at a pressure of 120 KPa. This pressure is reduced at each boiler to the pressure required by the burner. The water tube boilers receives digester gas at a pressure of 17 KPa while the fire tube boiler receives digester gas at 8 KPa. The digester gas fuel train is shown in Figure B211.

The "quality" or methane content of digester gas can vary between 55 and 65 percent by volume. Calorific analysis of the sludge gas may indicate that adjustments in sludge gas fueling rate at the cams on the jackshaft fire control are warranted during certain periods.

2. Combustion Air Supply System

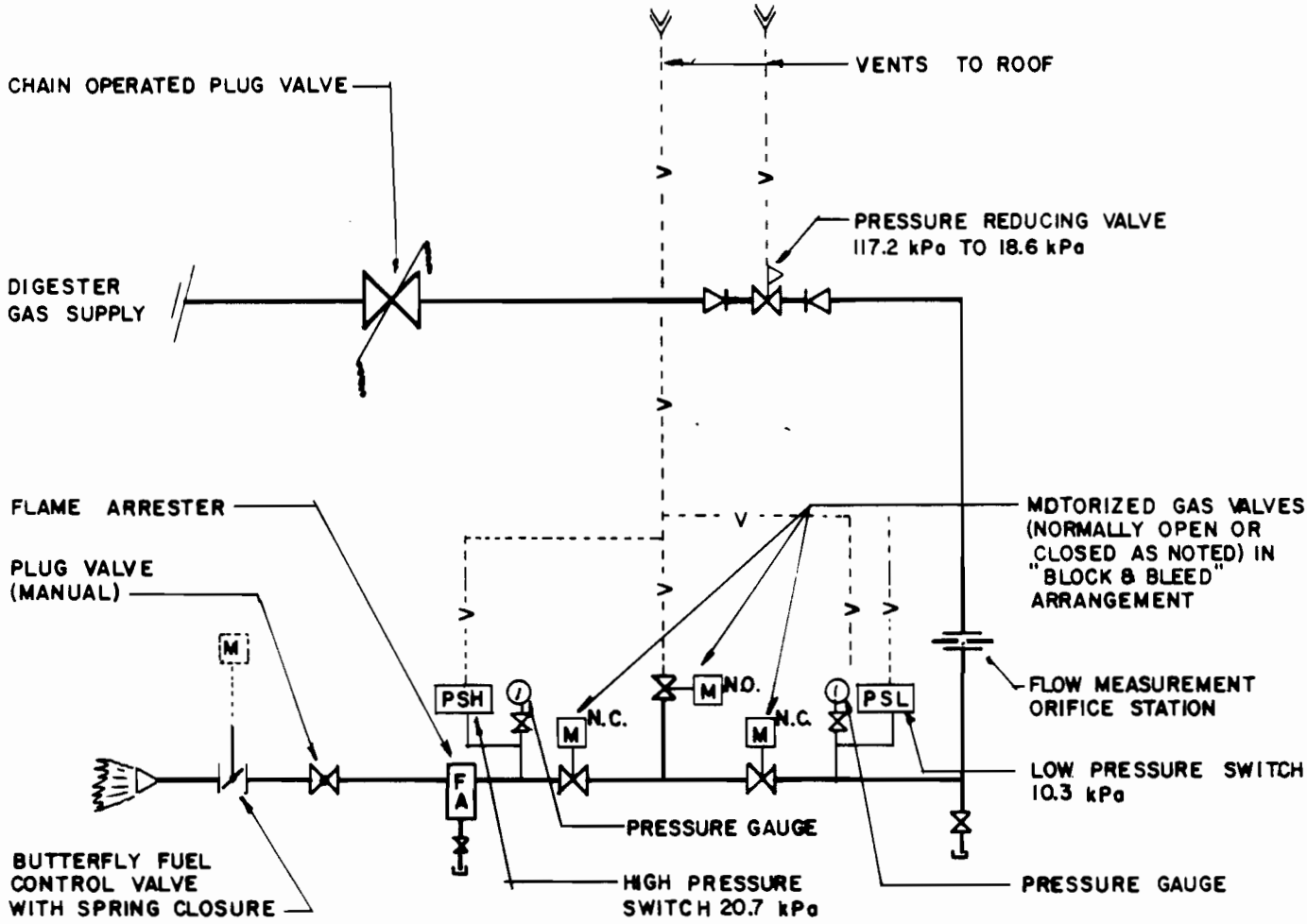
The supply of air for combustion is provided in two stages. The first stage is provided by air handling unit BF-20 mounted on the ceiling of the boiler room unit BF-20 supplies 7600 l/s of tempered outdoor air to the boiler room. This air is sufficient to meet the combustion air and excess air requirements of all the boilers at maximum firing rate.



NATURAL GAS FUEL TRAIN

(BOILER NO. 1 SHOWN)

fig. B210



DIGESTER GAS FUEL TRAIN

(BOILER No. 1 SHOWN)

fig. B211

The second stage of combustion air supply is at the burner. Each burner is equipped with a centrifugal combustion air supply fan with a motorized discharge damper to control supplied volume. The three watertube boilers have the fan mounted externally to the main boiler casing. The fire tube boiler has the fan mounted integrally in the front door of the boiler.

The individual burner supply air capacities at normal maximum firing rates are approximately:

BH-1, BH-2, BH-3 - 1000 L/S
BH-4 - 1500 L/S

3. Ignition and Pilot System

The flame ignition system consists of a natural gas pilot that is spark ignited from the flame safety controller. The pilot is fired only until 15 seconds after the main gas valve is allowed to open (see Fig.B209 - Operating Sequence of Flame Safety Control) and then a pilot solonoid valve shuts the pilot gas supply off.

E. Operating Procedures

1. Start Up

Service Start

This is a condition where the boiler has been removed from service for inspection or cleaning. The boiler is empty and the fuel supplies are shut off at the manual shut off valves on the gas trains. Before beginning this procedure, check to ensure that any piping removed during service has been replaced, including all fuel, drain, vent, relief, and blowdown piping.

1. Open the vent on the boiler inlet manifold of boilers Bh-1, BH-2 and BH-3, or on the top of boiler BH-4.

2. Close the boiler drain valves.

3. Fill the boiler with potable water from the hose bib located on the inlet to the fill water tank. The boiler should be filled slowly.

4. Allow the boiler to warm up to room temperature after it is filled.

5. Close the vent.

6. Open the boiler inlet shut off bypass valve (38 mm ø) very slowly to bring the boiler up to system pressure.

7. Check thoroughly for any leakage externally and internally.

8. Replace the service access doors.

9. Close the boiler inlet shut off bypass valve.

10. Open the boiler discharge shut off valve and the discharge header shut off valve.

The boiler is now ready for a cold start.

Cold Start

This is a condition where a boiler at room temperature with no system water flow through it is to be brought into service. This procedure assumes that the heating system is in service (hot) when the boiler start is initiated. The start up procedure is listed below in step by step form. Before beginning this procedure, ensure the Boiler Area ventilation system is operating.

1. Close the boiler inlet shut-off valve.

2. Open the boiler discharge shut off valves (two) - (one at the boiler discharge and one at the discharge header).

3. Start the boiler circulating pump for the boiler to be brought into service from the field device panel in the boiler area control room.

4. Slowly open the inlet shut off bypass valve.

5. Start the blend pump (BH-4 only) from the boiler control panel (see Figure B206).

6. Monitor the discharge temperature of the boiler at the field device panel until the boiler water leaving temperature is approximately equal to the boiler water entering temperature.

7. Open the boiler inlet shut off valve.

8. Monitor the water flow through the boiler from the field device panel in the boiler area control room (Figure B301). The flow through the three water tube boilers (BH-1, BH-2, and BH-3) should be approximately 40 liters per second and the flow through the fire tube boiler (BH-4) should be approximately 70 liters per second.

   Note: At this point the boiler is ready to be fired as it has been properly warmed to system temperature and proper water flow has been established. Before proceeding, the type of fuel to be used is determined. Digester gas as opposed to natural gas is always used provided adequate supply is available.

   The available fuel supply is monitored from field device panel (DFDP-1) located in the digester area control room (refer to Digester Area Manual). The total fuel consumption of the boilers under fire is monitored by totalling the digester gas flows indicated at BFDP-1 (Figure B203). To select digester gas as the fuel, gas available from

the gas sphere and the booster compressors must be equal to, or greater than, present firing rate plus the firing rate of the boiler to be fired.

9. Select fuel to be used at the boiler control panel (Figure B205 or Figure B206).

10. Depress the manual [MAN] key on the boiler firing controller (Figure 207) mounted on the boiler control panel (Figure B205 and Figure B206). Then depress the output [OUT] key and utilize the slew key to bring the output signal to minimum. The boiler can now be fired and will fire at minimum rate.

11. Open the boiler control panel during the boiler start to observe the burner safety controller (Figure B208) located inside the panel. Also refer to Figure B209 for proper sequence and listing of operations.

12. Start the boiler from the on/off switch on the boiler control panel.

13. Observe the burner safety controller as it moves through the start up sequence (Figure B209) and ensure sequence is completed to the flame on/run condition and the boiler is operating at minimum firing rate as determined in (9) above.

14. Increase the firing rate gradually by increments of 10% twice per hour until the discharge temperature (PV) is equal to set temperature (SP).

15. Transfer firing control to automatic fire control by depressing the [AUTO] key of the burner firing controller (Provox).

At this point the boiler can also be made available to the plant firing control by depressing the direct digital control function key [DDC]. Control of the boiler will then be from the plant master controller through the boiler master controller in the boiler area control room.

WARNING: A boiler should not be left after startup until the unit has been observed in operation for a period of time that confirms the boiler and system have stabilized.

During this period the flame should be observed to note any operating pecularities. Also, the general operation of the boiler should be checked to note any pecularities such as noisy pump or fan units. Boiler water flow, flue gas temperature, and outlet temperature are to be observed to note any irregularities.

Warm Start

This is a condition where the boiler is receiving a full flow of heated system water, but has been turned off manually or by automatic shut down. If the shut down has been automatic, the reason for the shutdown must be established before a restart is attempted.

To start a warm boiler, refer to the sequence for a cold start and begin at Step (8).

2. Shut Down

There is a safety shutdown, and two other types of shutdowns that may be operator executed. One is an emergency shutdown, and the other is a normal shutdown. The flame safety controls can also shut the boiler down. The shut down modes and the procedures for each are as follows:

Safety Shutdown:

This is a condition where the boiler fueling system is shut down automatically because of a condition that would affect the safe operation of the boiler. The shutdown is initiated by the flame safety controller and closes off all fuel supply to the burner. A safety shutdown produces

an alarm signal in the boiler room, which is also relayed to the central computer system for recognition at the central operating station. Procedures are listed below:

1. Close the manual fuel shut off valves on both fuel supplies to the boiler in alarm.

2. Shut the boiler down at the motor control centre in boiler area (Figure B502).

3. Notify the chief operator immediately that a safety shutdown has occurred.

4. Start up the boiler designated standby boiler, following proper start up procedures.

Emergency Shut Down

This is a condition where an unsafe or unusual boiler operating condition is noted by an operator on a walk through check of the boiler area, or a condition occurs where the continued operation of a boiler would result in life safety hazards or property damage. The procedures are similar to the safety shutdown but are listed below in full:

1. Shut down the boiler at the shut off switch on the boiler panel (Figure B205 and B206).

2. Close the manual fuel shut off valves on both fuel supplies to the boiler.

3. Shut the boiler down at the motor control centre (Figure B502) in the boiler area.

4. Notify the chief operator immediately that an emergency shut down has been initiated.

5. Start up the boiler designated standby boiler following proper start up procedures.

Normal Shut Down

This is a scheduled or planned shutdown of a boiler and should be used if at all possible in place of an emergency shutdown. Depending on the reasons for the shutdown, another boiler may have to be brought on line to meet the plant load before proceeding with the normal shut down. An evaluation of overall plant demand and availble standby capacity should be made prior to a normal shut down and if necessary another boiler should be started.

Procedures for a normal shutdown is listed below:

1. Start a replacement boiler if necessary.

2. Transfer the boiler to be shut down to manual (MAN) control at the boiler firing control (Figure B207) on the boiler control panel.

3. Reduce the boiler firing rate gradually at 10% increments every 15 minutes until minimum firing rate is reached.

4. Shut down the boiler at the main on-off switch on the boiler control panel (Figure B205 & B206).

5. Close the fuel shut off valve on both fuel supplies.

6. Cool the boiler down by operating the boiler circulating pump for approximately 30 minutes after boiler shut down.

7. Open the boiler inlet shut off bypass valve if the boiler is to act as standby, otherwise leave this valve closed.

8. Close the boiler inlet shut off valve on the pump supply to the boiler.

9. Shut down the boiler circulating pump at the computer/off/ hand station in the field device panel in the boiler area control room only if the boiler will not be acting as standby.

Boiler Draindown

Should the shut down be for the purpose of inspection, cleaning and maintenance, a boiler drain down will be required. Before this is initiated the boiler should be allowed to cool down and the following sequence completed:

1. Ensure both the boiler inlet shut off valve and inlet shut off bypass valve are both closed. The boiler circulating pump and, in the case of BH-4, the boiler blend pump should both be shut down.

2. Close both the boiler discharge shut off valves.

3. Open the boiler vent.

4. Allow the boiler to cool down to room tempereature.

5. Drain the boiler.