Integrating Human Performance Initiatives as Part of a Consolidated Edison Power Plant Upgrade

2014 IDEA Conference Seattle, WA

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Con Edison Steam System

Steam Operations Statistics

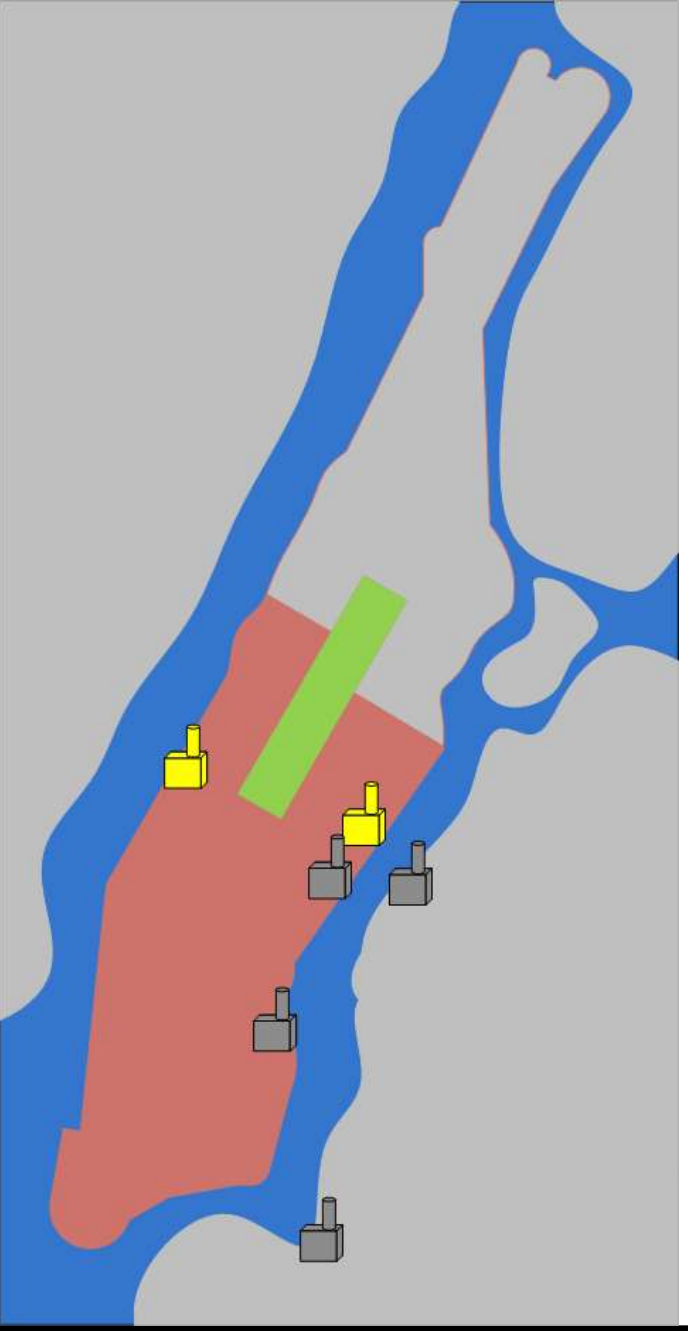
- Con Edison operates the largest steam system in the U.S.
  - ~ 1,700 customer accounts
  - ~ 105 miles of mains and service pipes
  - Service Territory is Manhattan only
- Approximately 20 billion pounds of steam send out each year
  - Space heating
  - Air conditioning
  - Domestic water heating
  - Humidification
  - Sterilization
- Seasonal Peak Forecasts
  - 9600 Mlbs/hr Winter peak load
  - 5300 Mlbs/hr Summer peak load

Con Edison Steam System

- The Con Edison Steam System is operated to meet the following priorities:
  - Safety
  - Environmental Compliance – NOx
  - Reliability
  - Economics

Steam Generating Station Capacity

Station	Steam (1,000lb/hr)	Electric (MW)
East River Units 1/10 & 2/20	3,200	293.5
East River Units 6/60 & 7/70	1,975	312.7
East River South	650	
Hudson Avenue	0	42.9
BNYCP	985	256.9
59th Street	**1,381**	**17.1**
60th Street	707	
74th Street	2,008	37.2
Ravenswood Steam	750	
Total Capacity	11,656	957.3



Gas Addition Projects

- Gas addition was performed at 59th Street and 74th Street Stations.
  - 59th Street
    - Annex boilers – 1000 klbs/hr
    - Package boilers – 381 klbs/hr
  - 74th Street
    - HP boilers – 1300 klbs/hr
    - Package boilers – 708 klbs/hr

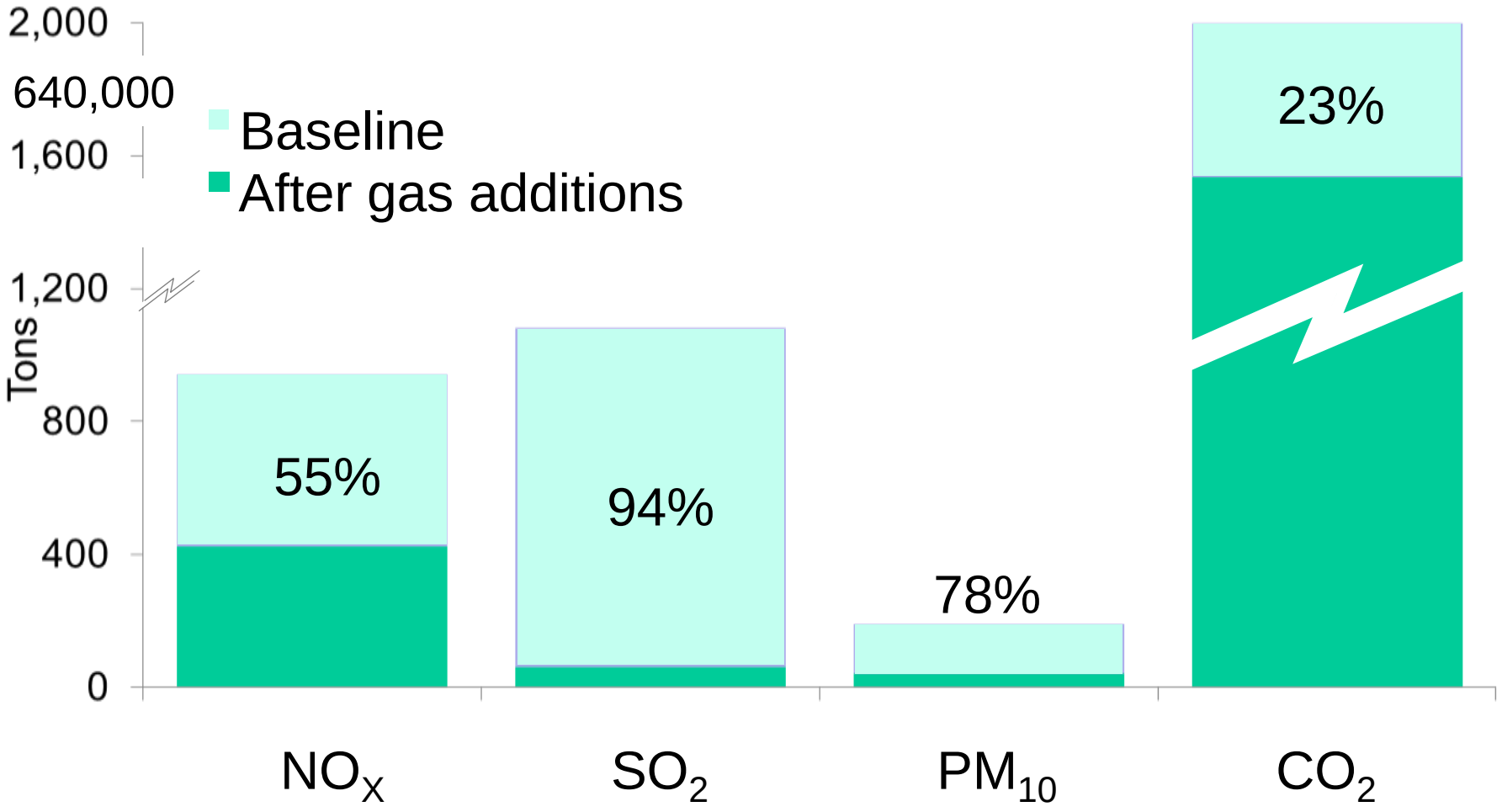
Reasons for Converting to Natural Gas

- Compliance with Environmental Regulations
  - NYSDEC NO_x RACT Regulation Effective July 2014
- Environmental Benefits to NYC
- Economic Benefit of Natural Gas Burning

Customer & Community Benefits

- Reduced emissions
- Reduce opacity events
- Fuel diversity & increased reliability
- Bill reduction
  - ~ $81 million fuel savings
  - ~10% annually

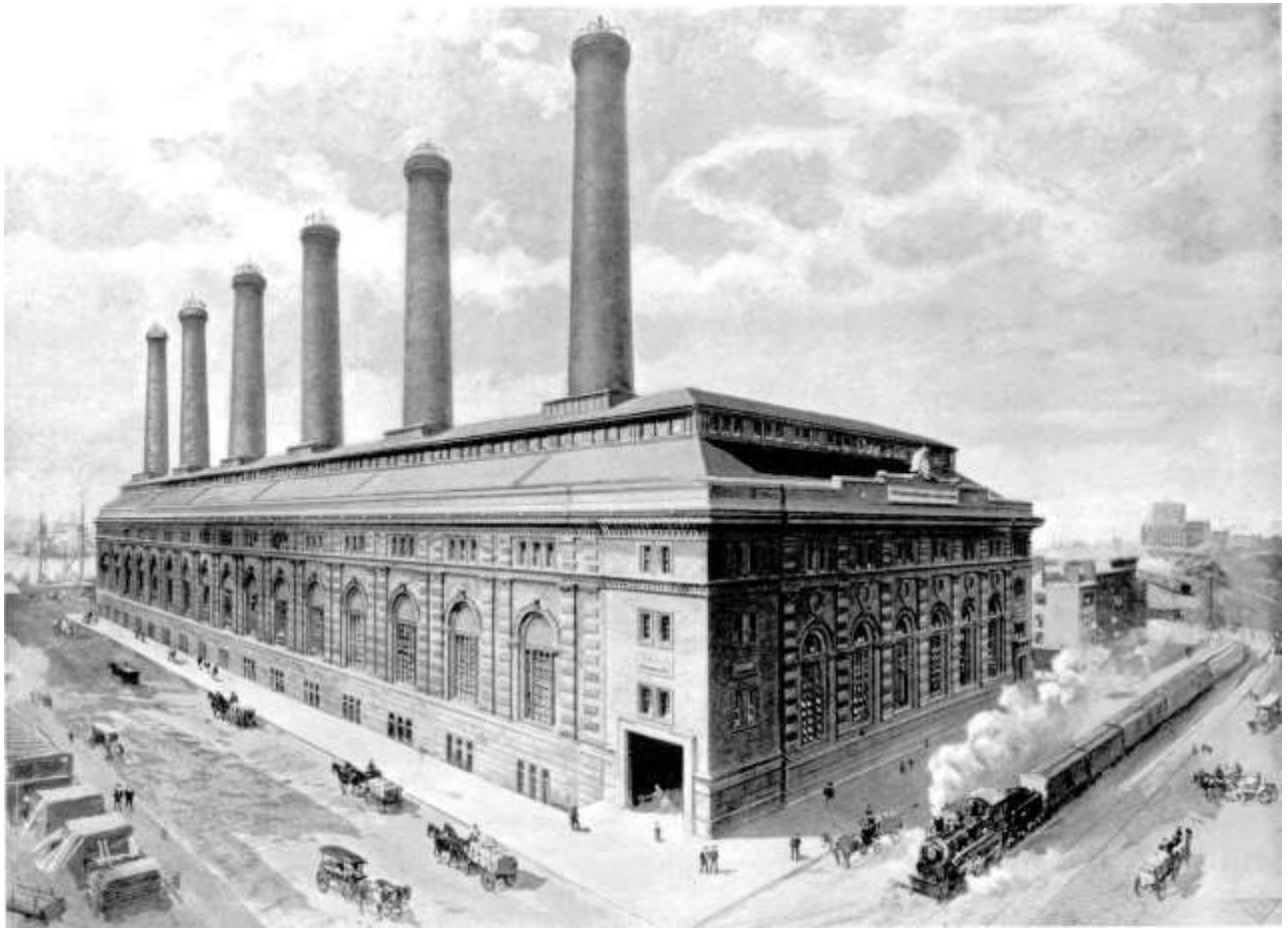
Environmental Benefits
Emissions Reduction Projections



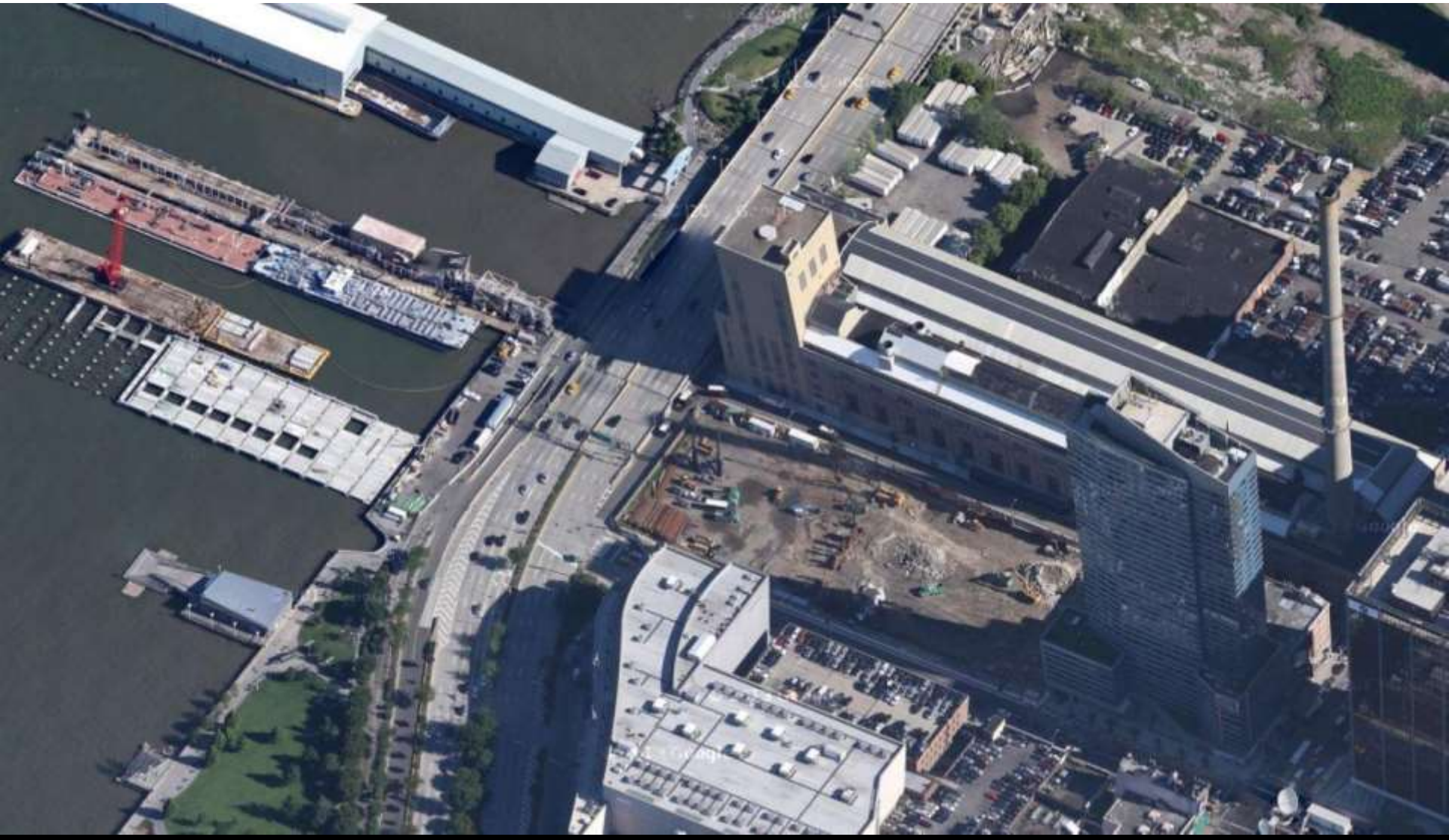
59th Street Station Overview

59TH Street Station

1904 59th Street Station (Interborough Rapid Transit Co.)



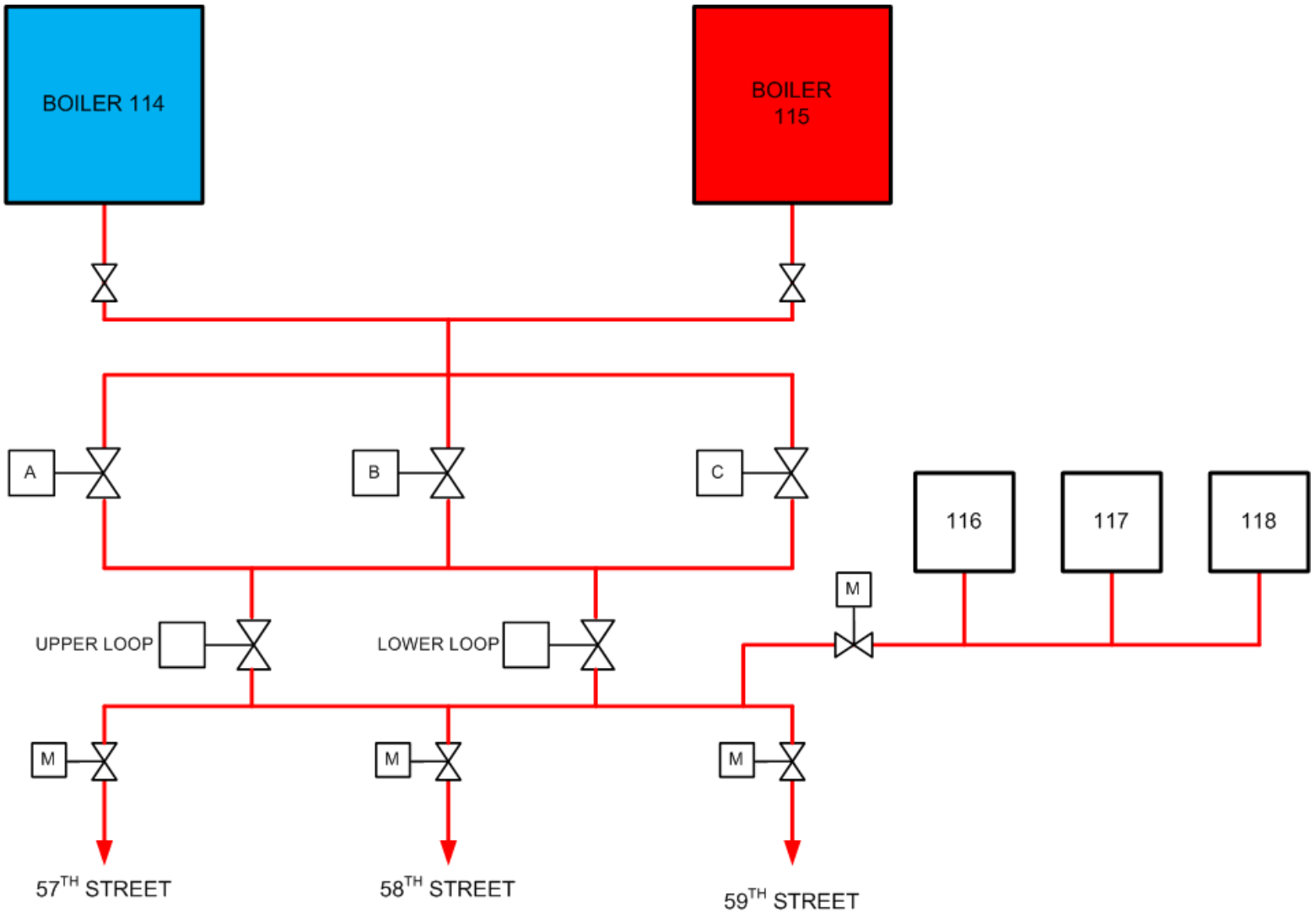
59th Street Station today



59th Street Boilers

- Annex boilers 114 and 115
  - Prior to gas addition burned only #6 fuel oil
  - Each boiler capable to 500 klbs/hr send out each
  - 1000 klbs/hr total output to steam distribution system
- Package Boilers 116, 117, and 118
  - Already dual fuel capable
  - Each boiler capable to 150 klbs/hr send out each
  - 350 klbs/hr total output to steam distribution system
- Gas Turbine GT1
  - Prior to gas addition burned only kerosene

59TH Street Steam Output Diagram



Modernization of 59th Street

Modernizing Drivers considered during upgrade

- In addition to Installation of a new Gas System, a new control system for operation of all boilers at the power plant was installed
  - Emission Reduction
  - Combustion Control
  - Hazard Mitigation
  - Aging Technology

Control Room Prior to Upgrade

Control Room After Upgrade

Human Performance Initiatives Were Required to Make This Major Transition

March 2013

July 2013

Human Performance Initiatives

- New Digital Control System (DCS) Installed
- Training
- Simulator
- SMARTboard

New Digital Control System (DCS)

Boiler Controls and Operator Interface

- Boiler Protection System
- Combustion Control
- Human Machine Interface
- State-of-the-Art Alarming

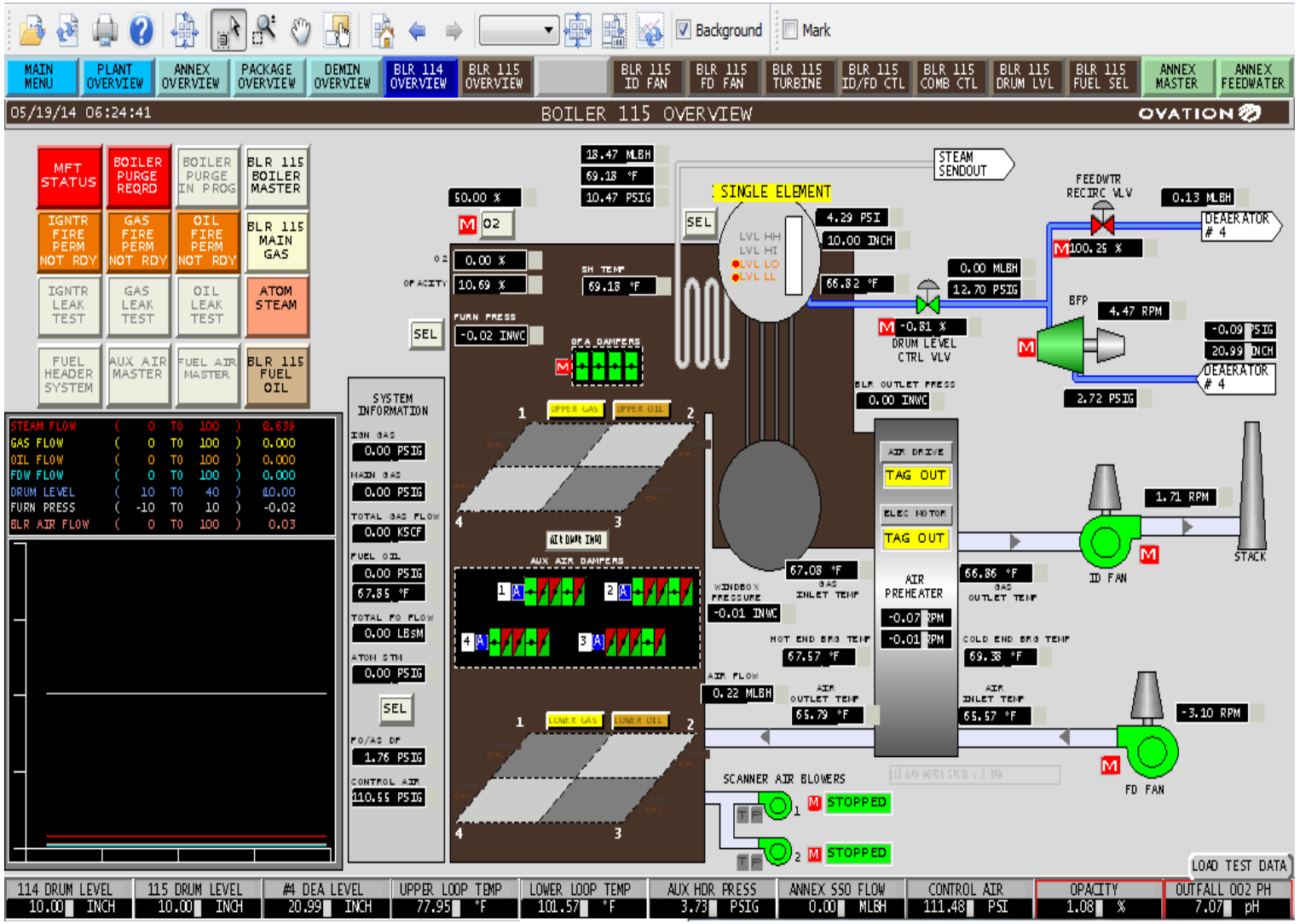
Pre-Commissioning

- Prior to construction key Engineering and Plant personnel spent significant time off-site conducting acceptance tests of equipment
  - Design Review - 1 week
  - Functional Review - 2 weeks
  - Hardware Test - 1 week
  - Factory Acceptance - 3 weeks

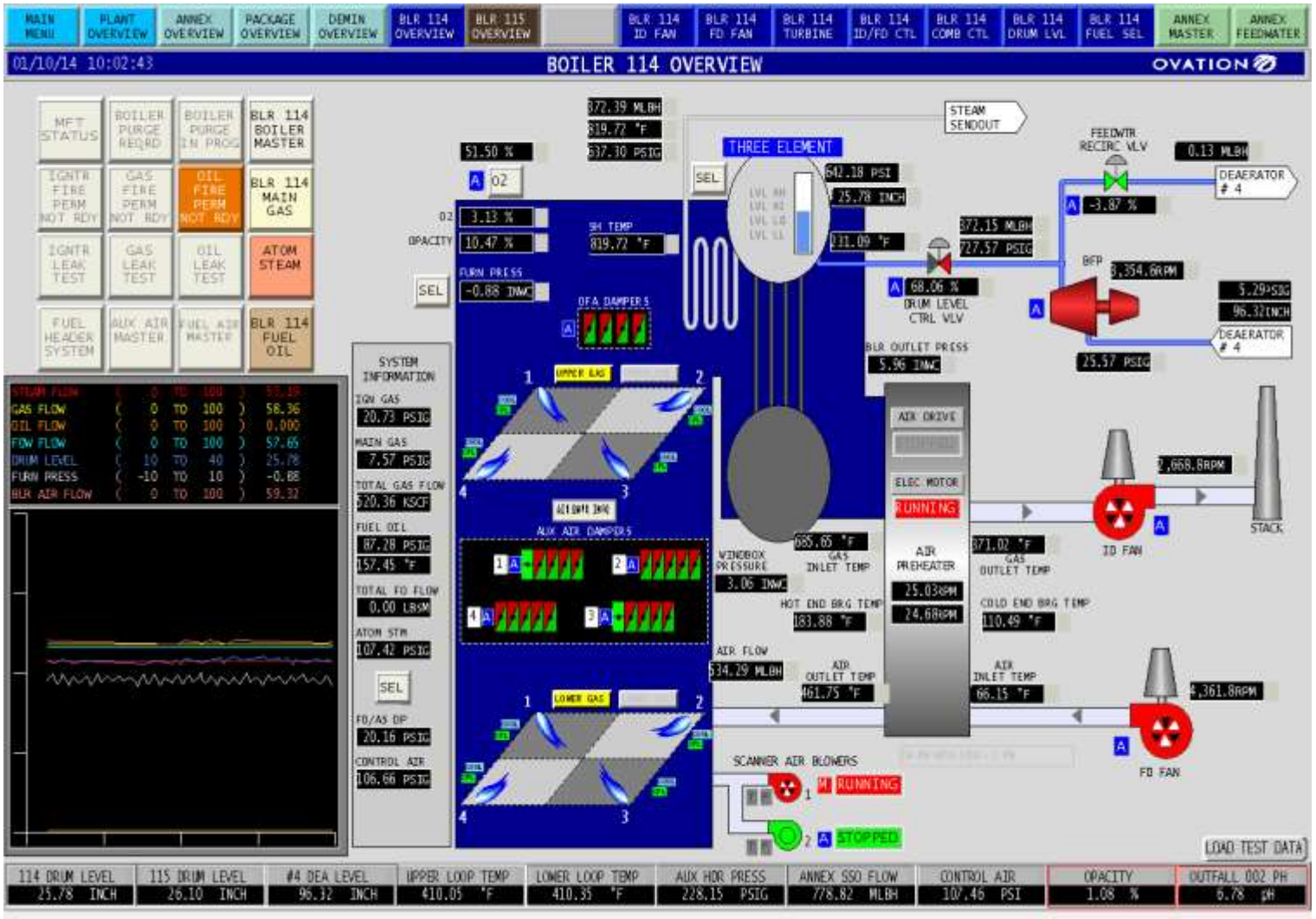
Operators helped develop DCS

- Control Room Operators directly involved with development
- HPI impacts
  - Developed and recommended screens which they knew would be useful based on their knowledge of the plant
  - Recommended Color Coding of boilers
    - 114 Boiler – Blue
    - 115 Boiler – Brown
    - 116 Boiler – Yellow
    - 117 Boiler – Green
    - 118 Boiler - Purple

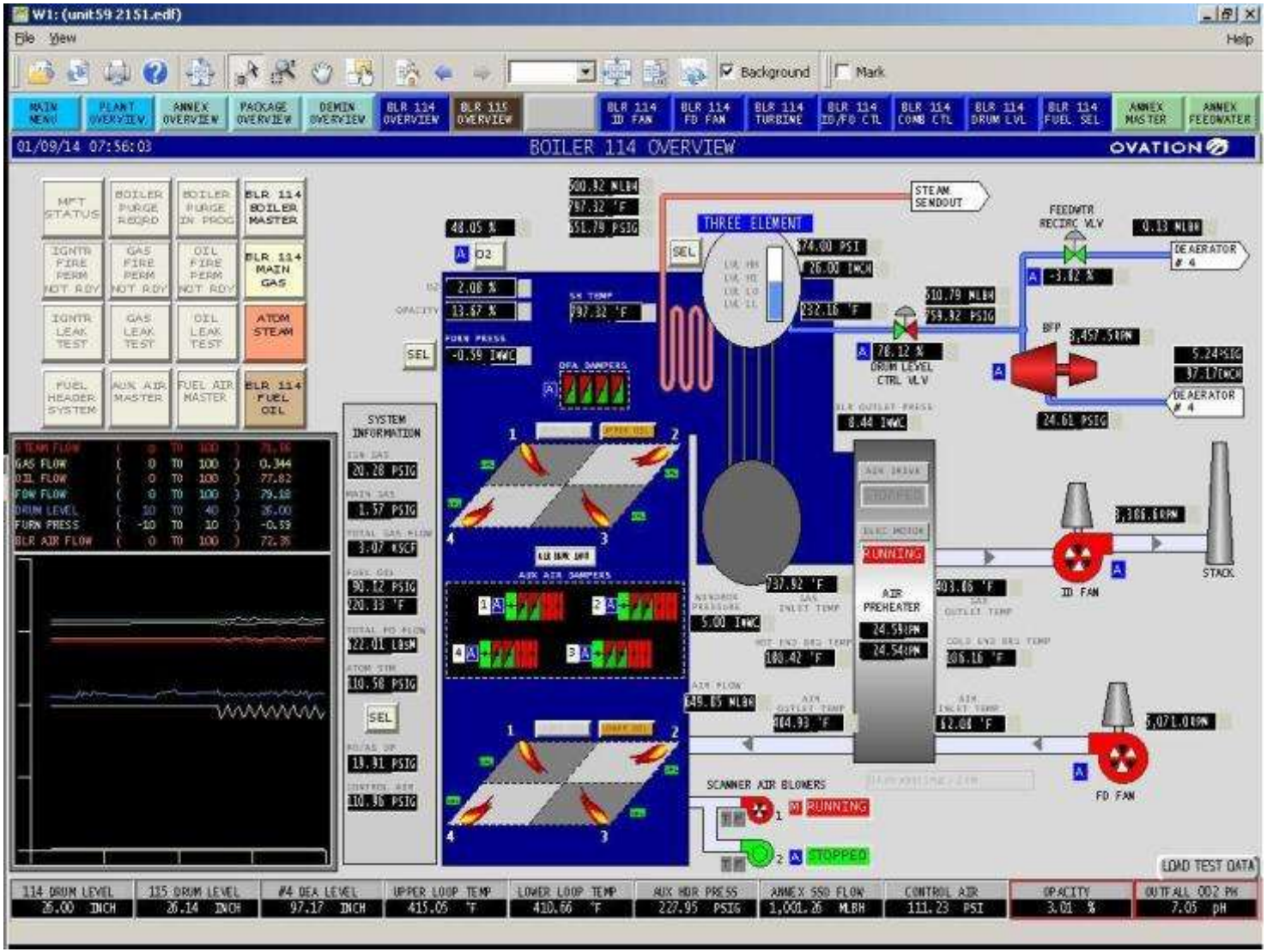
Boiler 115 - Offline



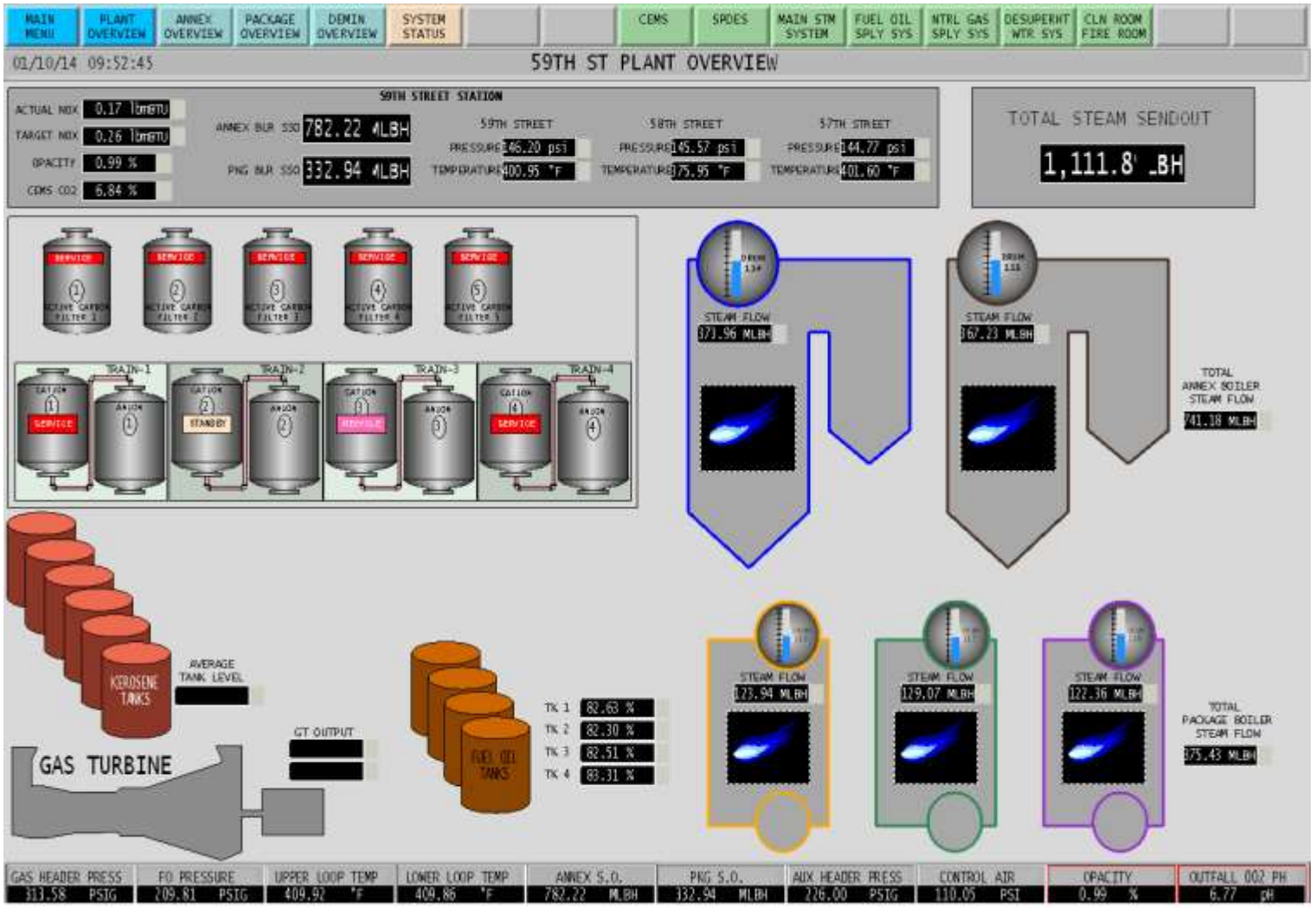
Boiler 114 – Online



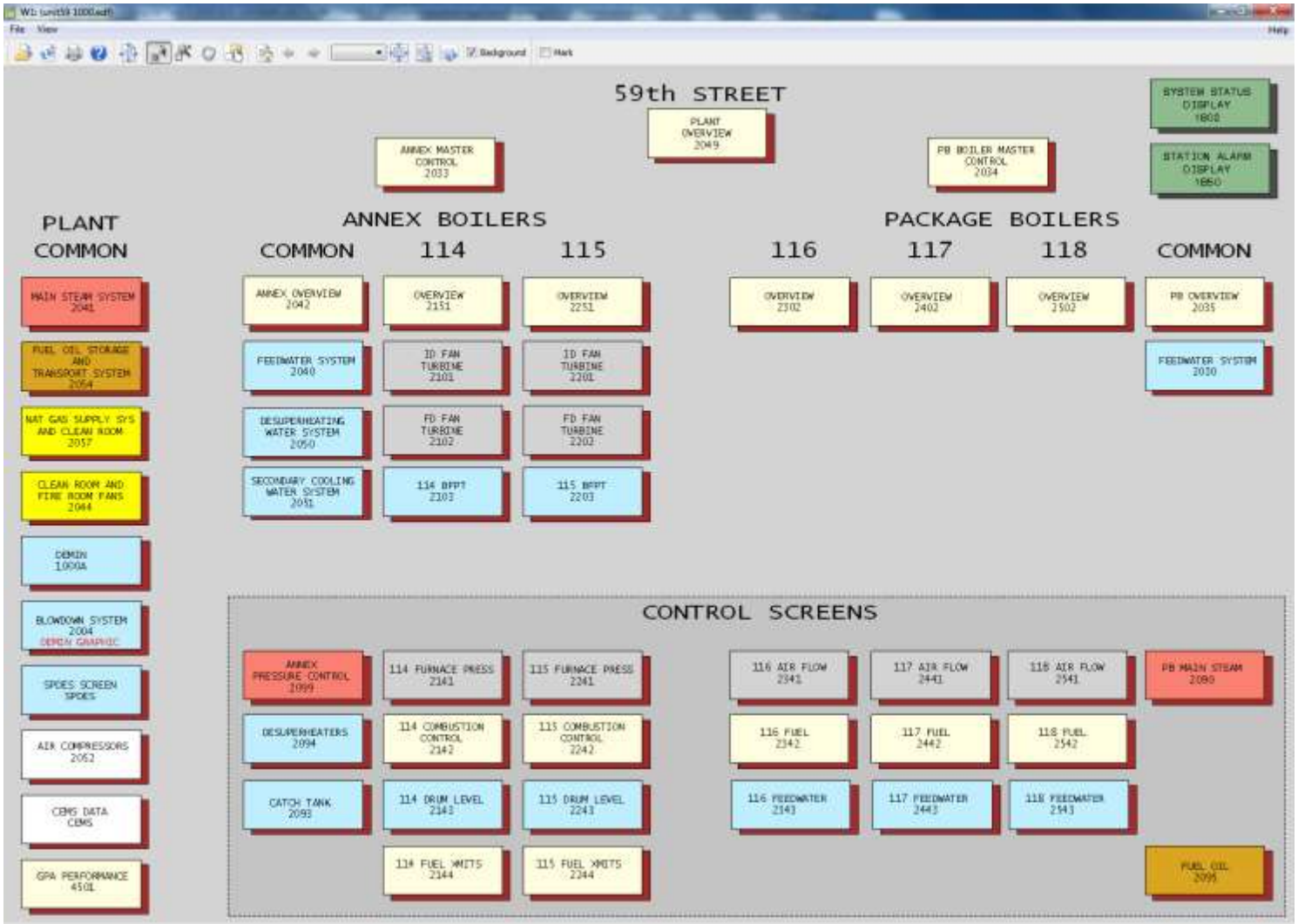
Boiler 114 – Online Burning Oil



Plant Overview Screens



Human Machine Interfaces



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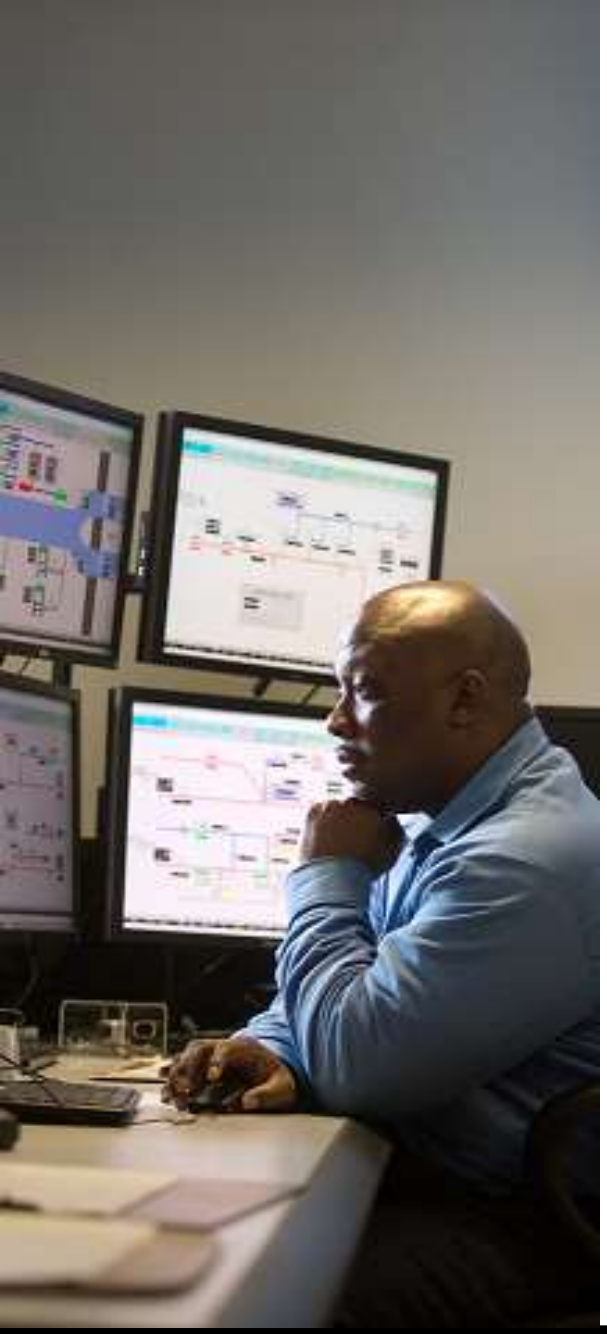
Training

- Operators underwent weeks of training learning new gas system. Included review of new station prints, classroom training, and review of new procedures.



Simulator

- Operators learned operation of plant on the simulator
- Simulator is effective training tool
- Different Scenarios are drilled for operators
- Re-fresher training now available for Operators

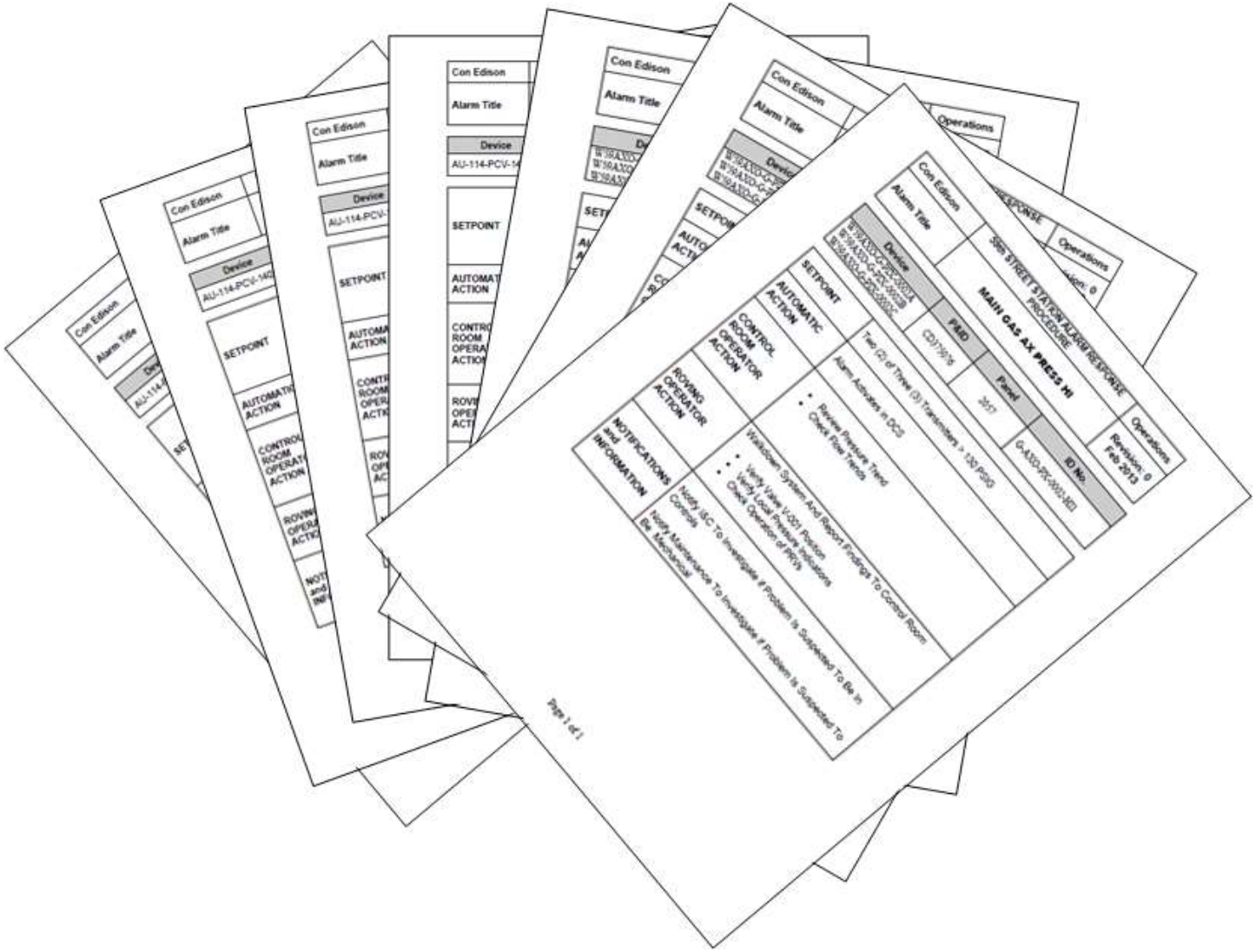
Simulator – Scenarios for Training

- Start-up and Shut-down of boilers
- Equipment Malfunctions
- Alarm Response Drills
- Qualification of New Operators
- Demineralization Plant Training

Procedures

- New start-up and shut-down procedures were developed for all plant equipment
- Gas specific procedures
  - Gas in for the station
  - Performing Nitrogen purge of gas mains
- Alarm Response Procedures
  - ARP’s linked directly into new DCS

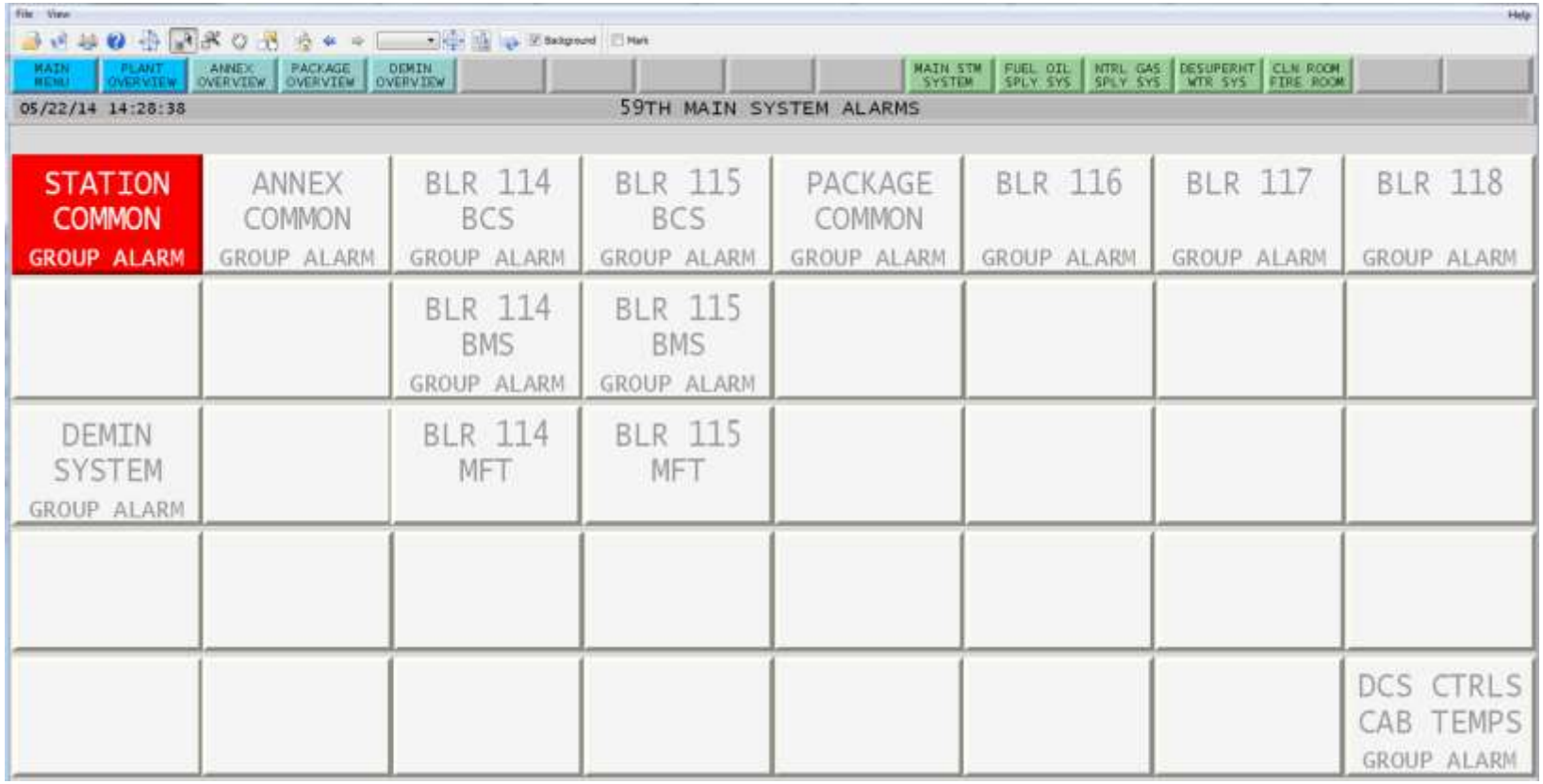
Alarm Response Procedures



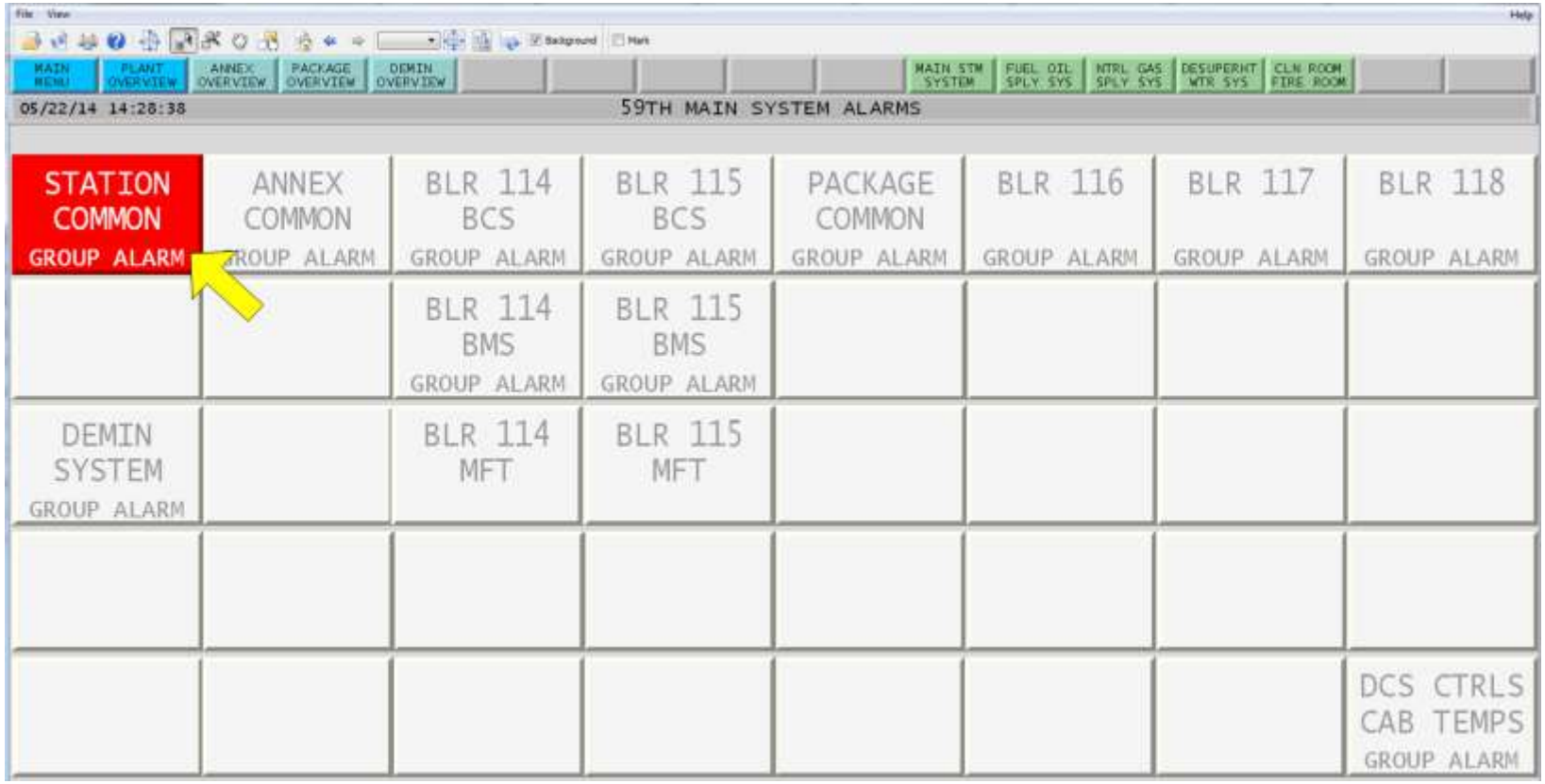
Alarm Response Procedures

Timestamp	Type	Kind	Priority	Name	Description	Value	Level
05/22/2014 11:15:39	ALRM		2	CC-00-LX-0136-HI.59ST@COED59ST	COOLING WTR TANK LVL HI	ALARM	
05/22/2014 11:15:39	ALRM		2	G-AX0-PX-0002-LO1.59ST@COED59ST	MAIN GAS AX PRESS LO	TRUE	
05/22/2014 11:14:20	ALRM		1	FP-UA-6.59ST@COED59ST	LFCP FIRE PNL TRBL/SUPERVISRY	TRUE	
05/22/2014 11:14:20	ALRM		1	FP-UA-8.59ST@COED59ST	MFCP FIRE PNL TRBLE/SUPV	TRUE	
05/20/2014 09:57:12	ALRM		3	FO-00-ZX-0003A-DEV.59ST@COED59ST	FO N&S PCV-0003A FB DEV	ALARM T	
05/09/2014 02:46:31	ALRM		3	CBA-118-AIX-1810-LO.59ST@COED59ST	118 WINDBOX O2 LOW	ALARM T	
05/09/2014 02:43:57	ALRM		3	CBA-116-AIX-1810-LO.59ST@COED59ST	116 WINDBOX O2 LOW	ALARM T	
05/08/2014 20:31:13	ALRM		3	FG-118-FI-TAG.59ST@COED59ST	118 ID FAN TAG-OUT	ALARM T	
05/08/2014 19:08:23	ALRM		3	CBA-118-FD-TAG.59ST@COED59ST	118 FD FAN TAG-OUT	ALARM T	
05/08/2014 19:08:07	ALRM		3	CBA-118-AH-TAG.59ST@COED59ST	118 AIR HEATER TAG-OUT	ALARM T	
05/08/2014 14:23:26	ALRM		3	FG-115-TE0080-BQ.59ST@COED59ST	115 ID FAN I/B BRG TEMP BQ	1 T	
05/08/2014 14:14:22	ALRM		3	FG-115-TE0081-BQ.59ST@COED59ST	115 ID FAN O/B BRG TEMP BQ	1 T	
05/08/2014 14:04:18	ALRM		3	FG-114-TE0039-BQ.59ST@COED59ST	114 ID FAN I/B BRG TEMP BQ	1 T	
05/08/2014 13:55:09	ALRM		3	CBA-115-TE0045-BQ.59ST@COED59ST	115 FD FAN I/B BRG TEMP BQ	1 T	
05/08/2014 13:46:43	ALRM		3	CBA-117-FD-TAG.59ST@COED59ST	117 FD FAN TAG-OUT	ALARM T	
05/08/2014 13:46:35	ALRM		3	FG-117-FI-TAG.59ST@COED59ST	117 ID FAN TAG-OUT	ALARM T	
05/08/2014 13:46:30	ALRM		3	CBA-117-AH-TAG.59ST@COED59ST	117 AIR HEATER TAG-OUT	ALARM T	
05/08/2014 13:45:46	ALRM		3	CBA-116-AH-TAG.59ST@COED59ST	116 AIR HEATER TAG-OUT	ALARM T	
05/08/2014 13:45:39	ALRM		3	CBA-116-FD-TAG.59ST@COED59ST	116 FD FAN TAG-OUT	ALARM T	

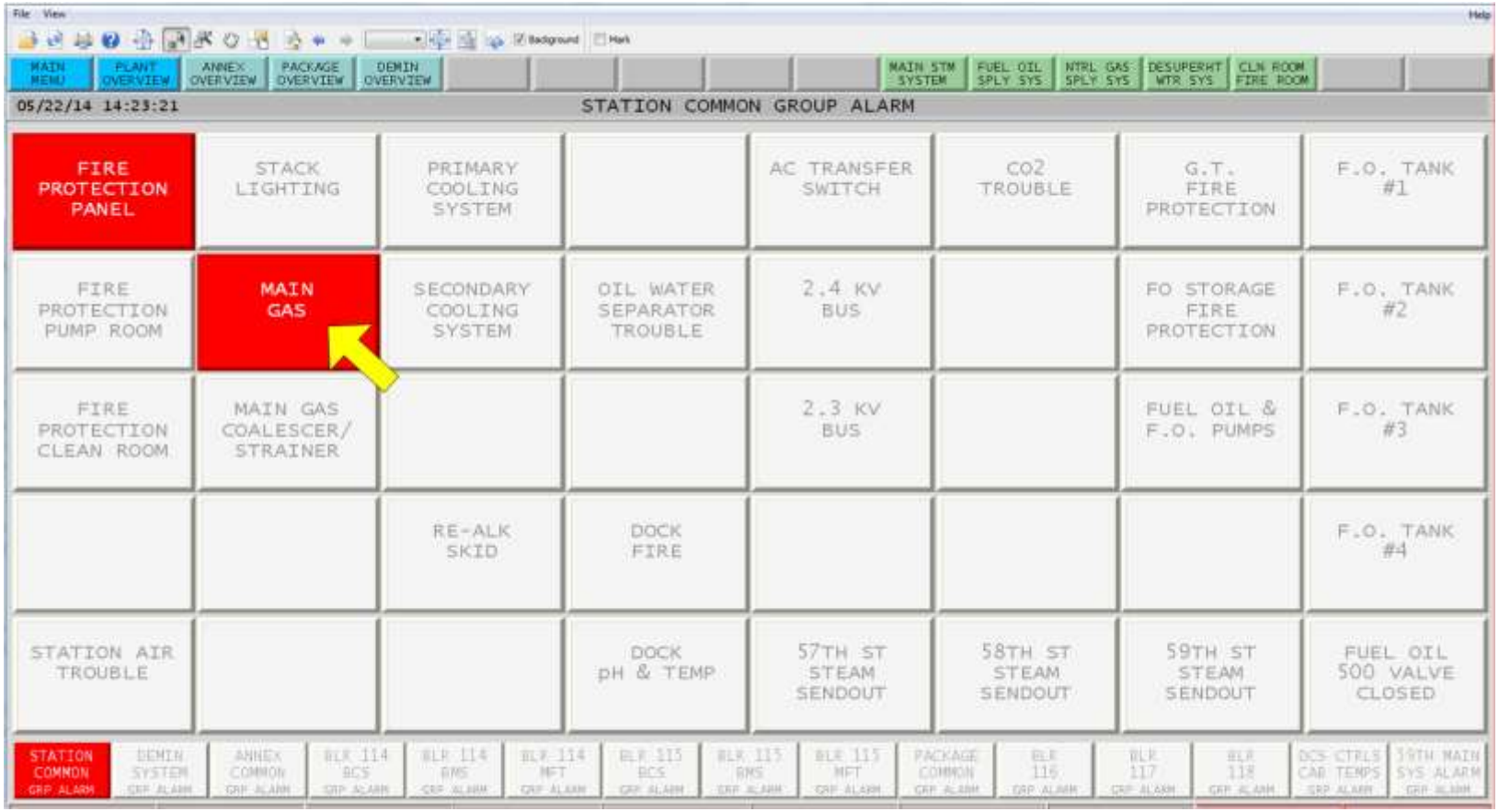
Alarm Response Procedures



Alarm Response Procedures



Alarm Response Procedures



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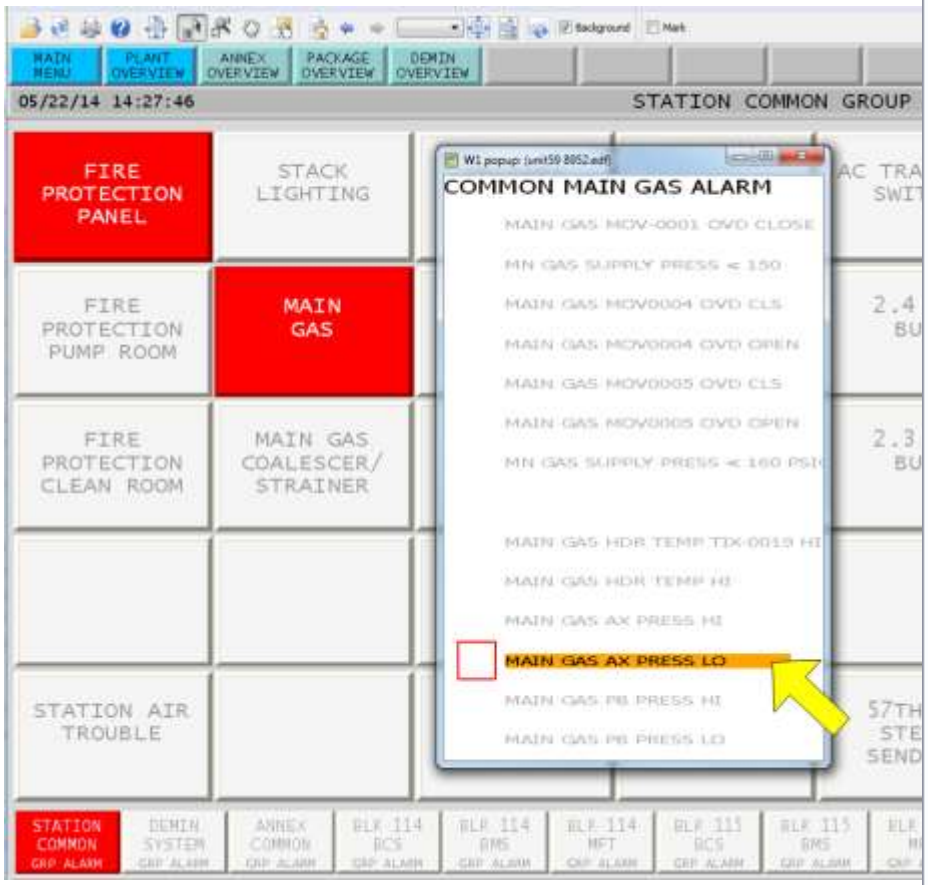

Con Edison	59th STREET STATION ALARM RESPONSE PROCEDURE	Operations
Alarm Title	MAIN GAS AX PRESS LO	Revision: 0 Feb 2013

Device	P&ID	Panel	ID No.
W59AXO-G-PIX-0002A W59AXO-G-PIX-0002B W59AXO-G-PIX-0002C	CD375076	2057	G-AXO-PX-0002-LO1

SETPOINT	Two (2) of Three (3) Transmitters < 50 PSIG
AUTOMATIC ACTION	Alarm Activates in DCS
CONTROL ROOM OPERATOR ACTION	• Review Pressure Trend • Check Flow Trends • Check Differential Pressure Across Strainers
ROVING OPERATOR ACTION	Walkdown System And Report Findings To Control Room • Verify Valve V-001 Fully Open • Verify Local Pressure Indication • Verify Vent Valves Closed • Check For Plugged Strainer
NOTIFICATIONS and INFORMATION	Notify I&C To Investigate if Problem Is Suspected To Be In Controls Notify Maintenance To Investigate if Problem Is Suspected To Be Mechanical

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SMARTboard

- Job Briefings
- Protection Overview
  - Energy Isolation
  - Portable Grounds
- Interactive Training
  - Drawing prints from memory
- Ability to network with other locations

Results

- Excellent transition from old system to new system
- Operated the new DCS without issues
- Best unit availability in the station's history
- No operating errors
- No lost time accidents
- Reduced Customer Costs
- Opacity reduction

Team Work

- 2013 Emerson Project of the Year Award - 59th Street Gas Addition Controls Upgrade
  - Enabled the company to overcome an industry or business challenge
  - Applied an innovative technology or process to reach a desired economic impact
  - Maximized process efficiency or minimized environmental impact

Future HPI Initiatives

3D Consequential Simulator

- Application and removal of portable grounds
- Testing Dead
  - High Voltage
  - Low Voltage
- Atmospheric Testing
- Energizing a High Energy Steam Line

Google Glass

- Training
  - Recording and watching “How to Instructions”
- Operating
  - Knowing plant conditions while in the field

Questions?