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Requirements in Nuclear Applications – Digital Videograph Recorders

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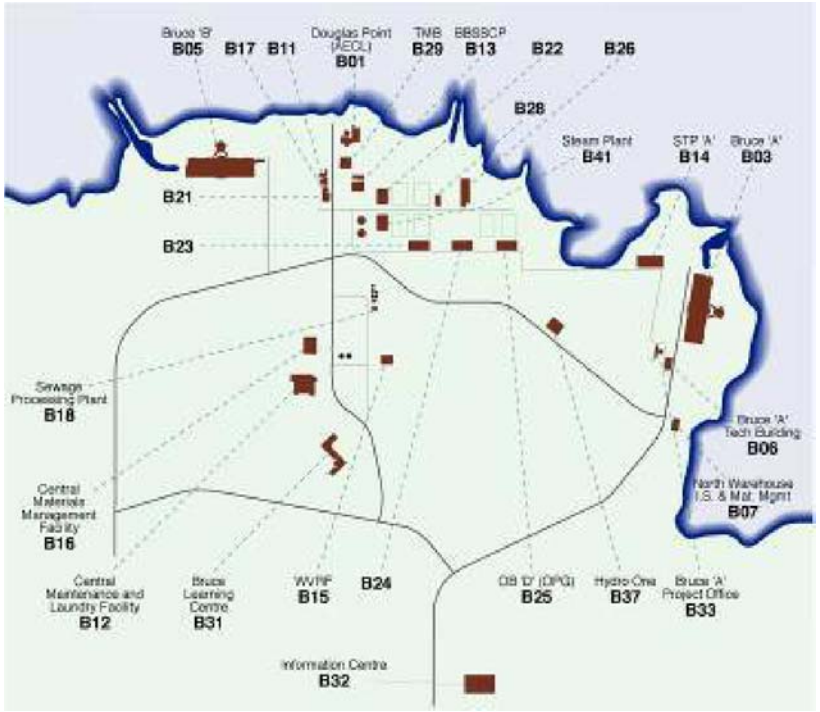
Bruce Power

PRESENTATION AGENDA

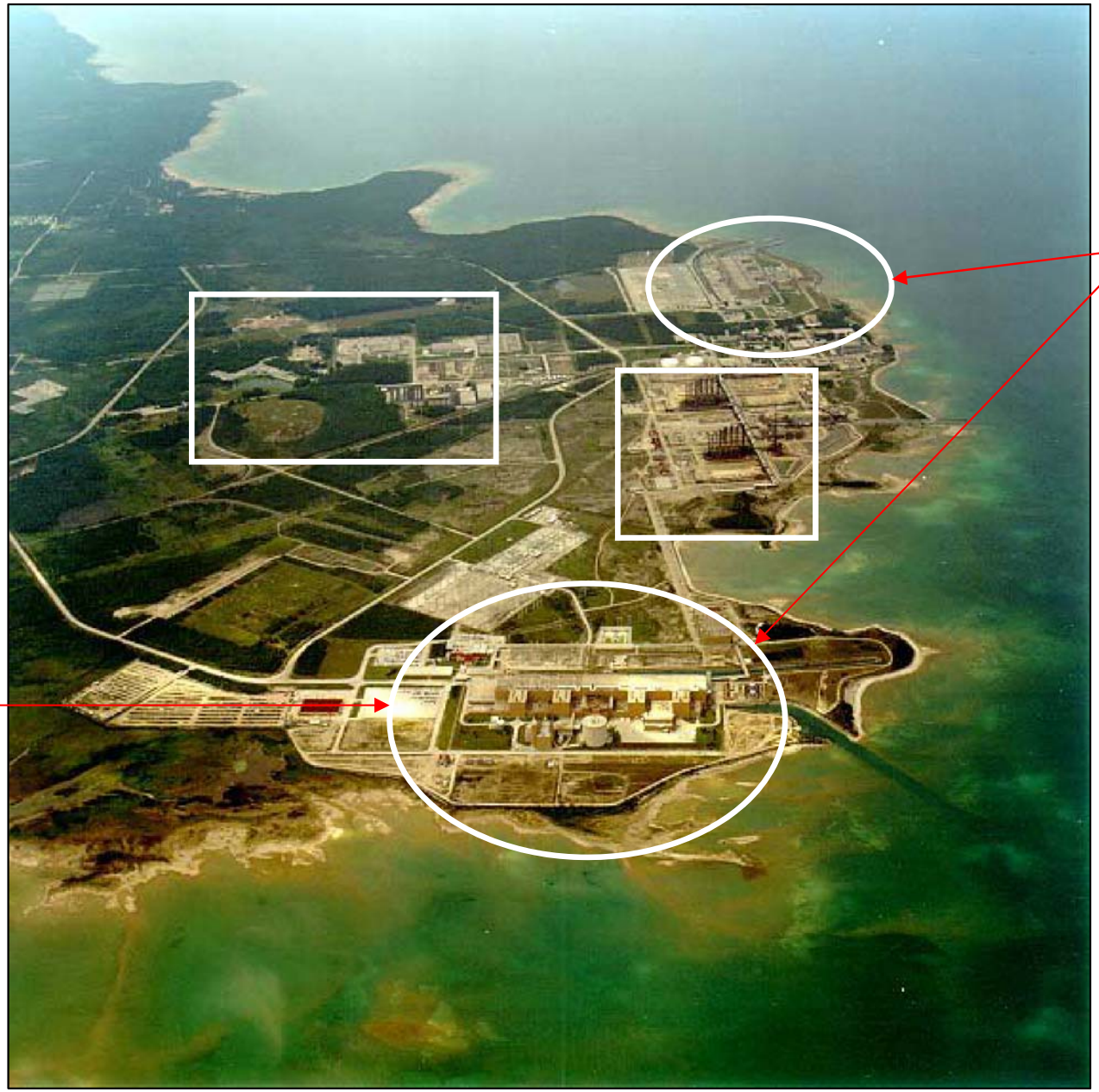
- Bruce Power
- The Project
- Software Quality Assurance
- Human Factors
- Stakeholder Participation
- Configuration and Archiving
- Q&A

About Bruce Power

- Largest nuclear site in North America
  - Spread over 2,300 acres and has 56 kms of roadways
  - Includes supporting infrastructure, training centre, Visitors' Centre
  - About 3,700 employees



BRUCE POWER SITE



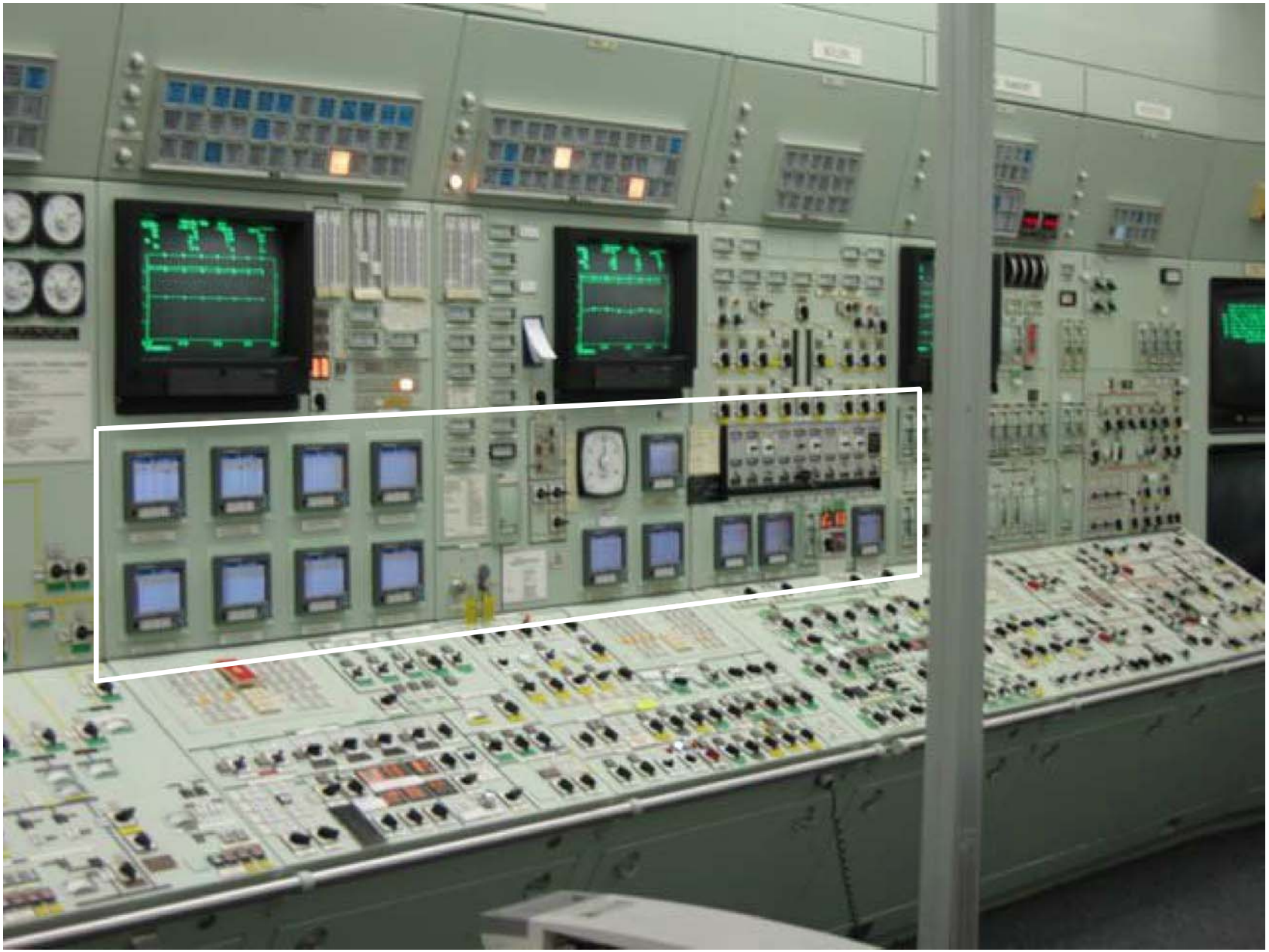
Presently 6 Operating Units. Capacity of 4,700 MW

Another 1,500 MW to be added with restart of Units 1 and 2

THE PROJECT

- Seventeen (17) Chart Recorders on MCR Panels per Unit
- Business Case Built on Obsolescence
- Priority on Operations Need / Perceived Risk
- Objectives:
  - » Form / Fit / Function
  - » Training
  - » Modification Impact

MAIN CONTROL ROOM PANELS



SOFTWARE QUALITY ASSURANCE

- Bruce Power have specific set of Sector Guidelines and Requirements for SQA
- OASES SQA Standard = Ontario Hydro AECL Software Engineering Standards

  Suite of software standards which covers:

  - Categorization
  - Graded Software Engineering Standards
  - Guideline for Qualification of Software Products
  - Guideline for Assessment of Configurable Software
  - Modification of Existing Software

- Categorization

- OASES Guideline for Categorization
- Dependant on Nuclear Safety Criticality and Risk of Target Application
- Also defined as Plant Safety Significance versus Software Failure Impact

- Graded Categories:
  - CAT I — Highest Safety Significance
  - CAT II — Moderate Safety Significance
  - CAT III — Lowest Safety Significance

- Standards for Software Engineering

- Each Category I, II or III has specific standards for the development of software.
- Standards were developed in early 1990s in response to Regulator's Action Item.
- Standards developed with focus on Custom Software written for Specific Applications.
- OASES standards are only followed by select manufacturers with primary interest in CANDU Reactors.

SOFTWARE QUALITY ASSURANCE

- Guide for Qualification of Software Products

- Recognizes products are not developed to OASES Standards.
- Attempts to Qualify software development processes by other manufactures for defined Safety Category.
- Uses Qualification Methods to Audit Manufacturers SQA Capabilities.
- Assessment tools are Checklists, Questionnaires, Site visits, Interviews.

- Guideline for Assessment of Configurable Software

- The development of software is not our core business.
- Bruce Power relies on Vendors / Manufacturers to configure devices for specific applications.
- Guideline is used to ensure proper Engineering i.e. Requirements, Design, Implementation, are followed in the development of the configurable Software.
- Credit is given for Industry accepted Standards such as IEC 61131.

THIRD PARTY QUALIFICATION

- In Lieu of performing SQA Audit a Third Party Qualifications can be accepted.
- Credit taken for previous qualifications or certifications.
- Designer is still responsible for ensuring Application Independent Software related Qualification Concerns are addressed.
- Typical equivalent programs:
  - IEC 61508 SIL 1, 2, 3
  - IEC 61513 SIL 1, 2, 3
  - IEEE 7-4.3.2
  - CFR 50 APP B – 1E
  - ISO/IEC 12207

HUMAN FACTORS

- H.F Evaluation

- Human Factors is addressed for all Modifications.
- Questionnaire / Checklist will define Human Factors as Minor or Major.
- MAJOR = Human Factors Evaluation (HFE).
- HFE consists of 12 Elements which must be addressed or dispositioned in a HF Report.
- Focus is:
  - OPEX
  - TASK ANALYSIS
  - STAFFING
  - DESIGN

HUMAN FACTORS

- Human Factors….The Project

- Chart Recorder replacement was initially defined as Minor Change however HF Evaluation was completed based on “first time” change of MCR Panels.
- From HF perspective, change to Digital Videograph recorders considered Minimal Impact to Operators.
- Added tasks to display data considered minimal risk for Operator Error.
- Training requirements satisfied by Vendor demonstration and good Operating Manual.

HUMAN FACTORS - COMPARISON

SAME

Vertical Trend

Scales on Top

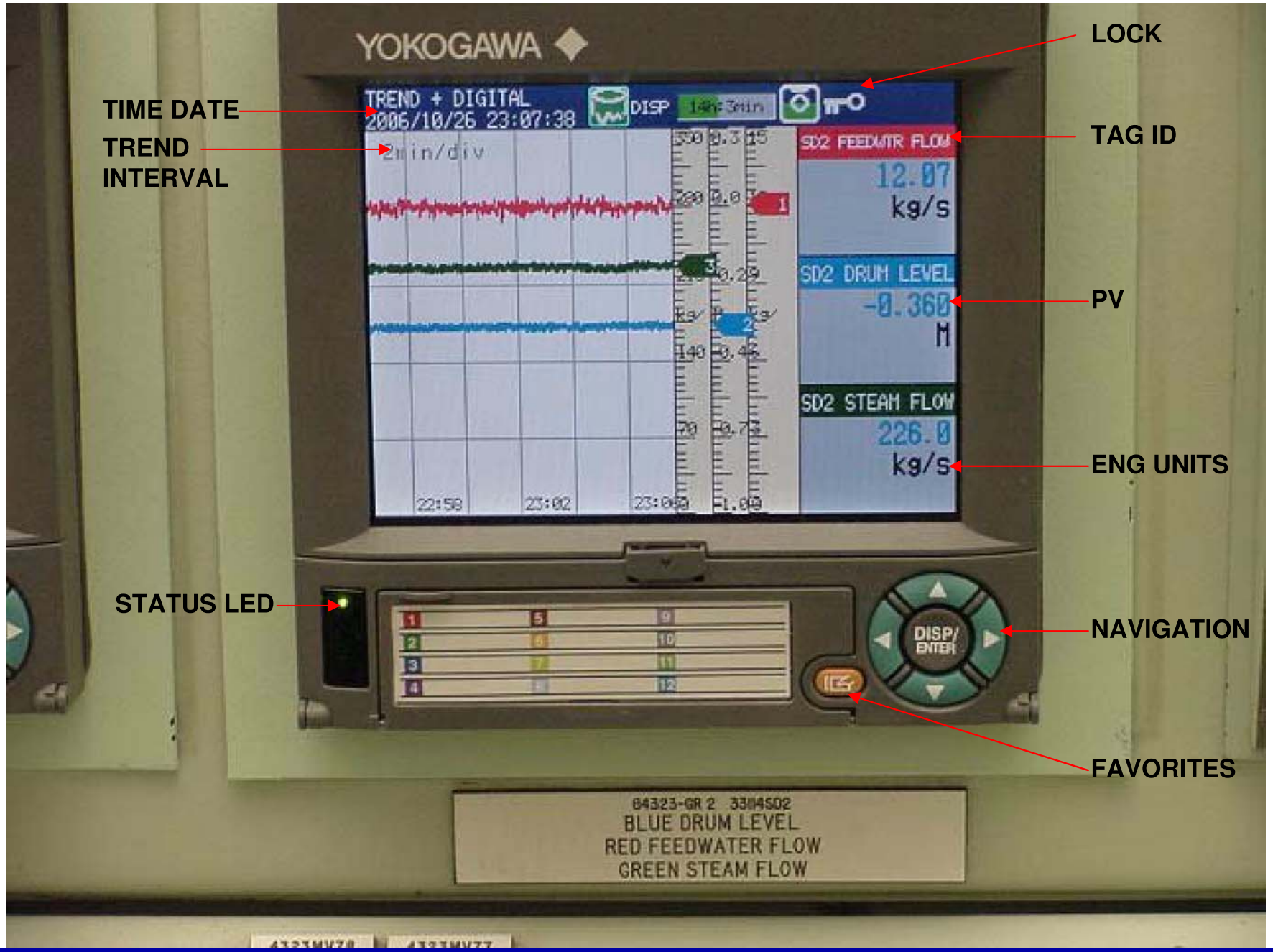
IMPROVED

Engineering Units

Time & Date

HUMAN FACTORS - IMPROVEMENTS

HUMAN FACTORS - INFORMATION



HUMAN FACTORS

HUMAN FACTORS

STAKEHOLDER PARTICIPATION

- Early Promotion of Product

- Vendor (C.B Engineering) on site after original contact with Bruce Power. Presentation to Design Department.
- As project went through funding Vendor assisted in Technical Specification details.
- Vendor and Yokogawa Rep on site with Operators for display of product.
- Yokogawa Rep assisted with Nuclear Standards such as Software Qualification Issues.
- Similar co-operation provided to other technical group i.e. Simulator, Restart Team.

CONFIGURATION

- User Friendly

- Users Manual and Operations Manual provided early in project for review of Maintenance, Operations and Engineering.
- Vendor to site prior to installation to assist Maintenance with configuration.
- After installation, Vendor to site for commissioning activities. Changes per Operations upon initial installation…through commissioning.
- Vendor back to site after 4 months of Operations Use for final configuration….existing.

CONFIGURATION

- Continued

- Taking existing configuration for Unit 4 devices and downloading into Unit 3 devices. Only change is TAG NAMES.
- Simulator configuration = download of presently installed devices
- Configuration Data Dump = Instruments Calibration History

ARCHIVING DATA

- DATA Query

- Data Retention by internal 80Mb memory and 32Mb compact flash media.
- Low priority to archive data as information is sent in parallel to Plant Information System, OSI PI.
- Have decided to make backups manual if information needs to be retrieved and taken externally.
- Option being presented to have the 17 devices per unit be networked together and download data to local server.
- Future consideration. Not a requirement due to present use of OSI PI.

QUESTIONS & ANSWERS

Q & A