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SCADA Display Design Based on Abnormal Situation Management Guidelines

Thursday, 20th of January 2022 | Technical Topic Webinar

Presented By

Mr Santhosh Ananthakrishan | EIT Lecturer and SCADA & RTS Engineer
Dr. Akhlaqur Rahman | EIT Course Coordinator and Lecturer – Industrial Automation Engineering

Common Questions/FAQs

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Agenda

1	Welcome and Introduction
2	What is Abnormal Situation Management (ASM)?
3	ASM guidelines in SCADA display design
4	Examples of ASM guidelines and displays
5	Studying Industrial Automation at EIT
6	Conclusion and Q&A

Introduction - Presenter

Mr Santhosh Ananthakrishan

EIT Lecturer and Senior E&I Engineer

A Chartered Professional Engineer with over 15 years of experience in the field of Electrical, Instrumentation & Control Engineering. Experienced in working on various phases of projects from concept, detailed design, commissioning through to closeout with strong focus and passion to deliver safely and on quality, cost and schedule.

I have configured many SCADA systems for Hazard industries like Oil & Gas and Chemical plants. I have developed operator displays incorporating Abnormal Situation Management guidelines. As a result, the operability of the high hazard facilities was enhanced.

Introduction - Presenter

Dr. Akhlaqur Rahman

EIT Course Coordinator and Lecturer – Industrial Automation Engineering

Akhlaqur is an academic with almost 10 years of experience in teaching various Electrical Engineering and Industrial Automation courses at Australian and overseas universities.
Akhlaqur is a member of Engineers Australia and a Senior member of IEEE. He has been involved in industry funded projects with several top universities and government institutes. His PhD project was mainly focused on developing task offloading algorithms for Cloud Robotics applications of Industry 4.0.
Akhlaqur is also the “Secretary for IEEE Young Professionals Executive Committee” (VIC Section). His current research interests lie in the area of Industrial IoT, Cloud Robotics and Virtual Manufacturing System with a focus on improving system efficiency through network optimization.

Introduction – Risks in Process Plants

In a process plant, there are many process parameters that may lead to a Abnormal Situation resulting in a catastrophic failure, if not bought under control in a timely manner. For e.g.

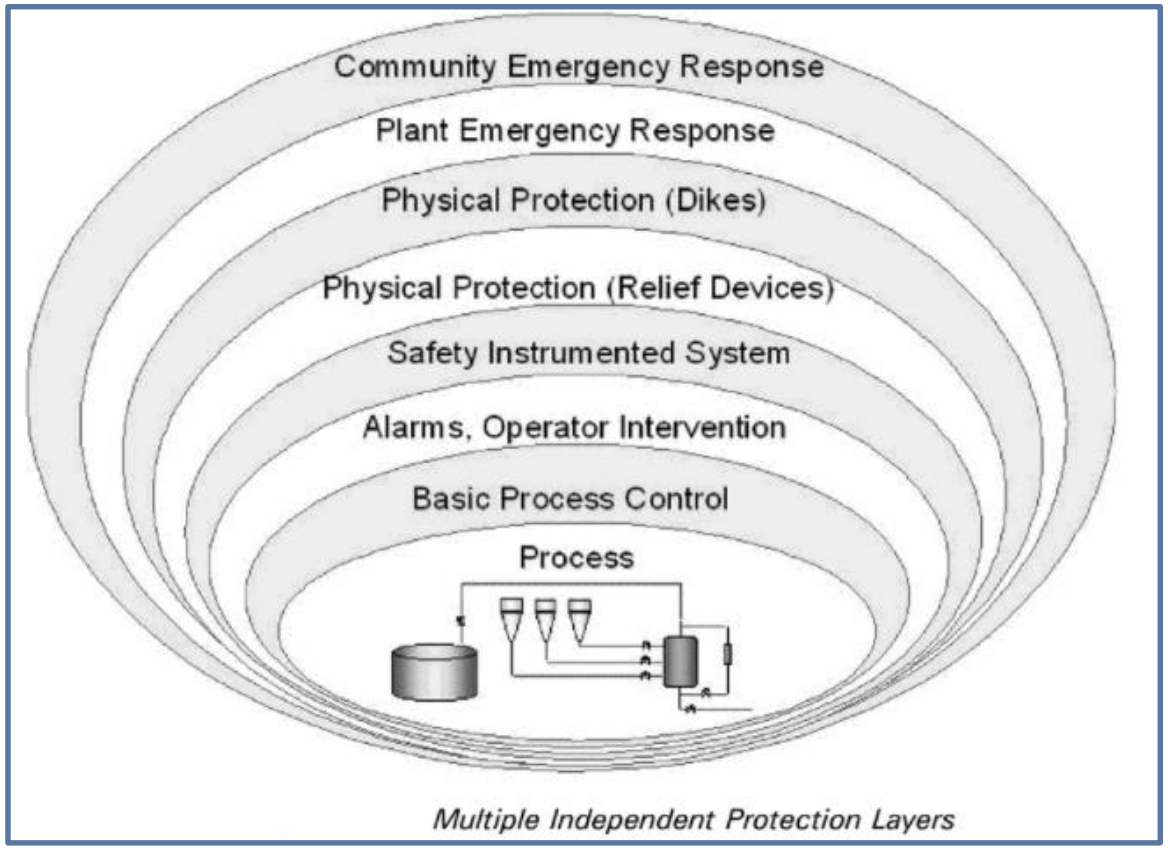
- High Pressure
- High Temperature
- High Flow
- Toxic Substances
- Moving parts
- Electricity etc…

Abnormal Situation Management (ASM)

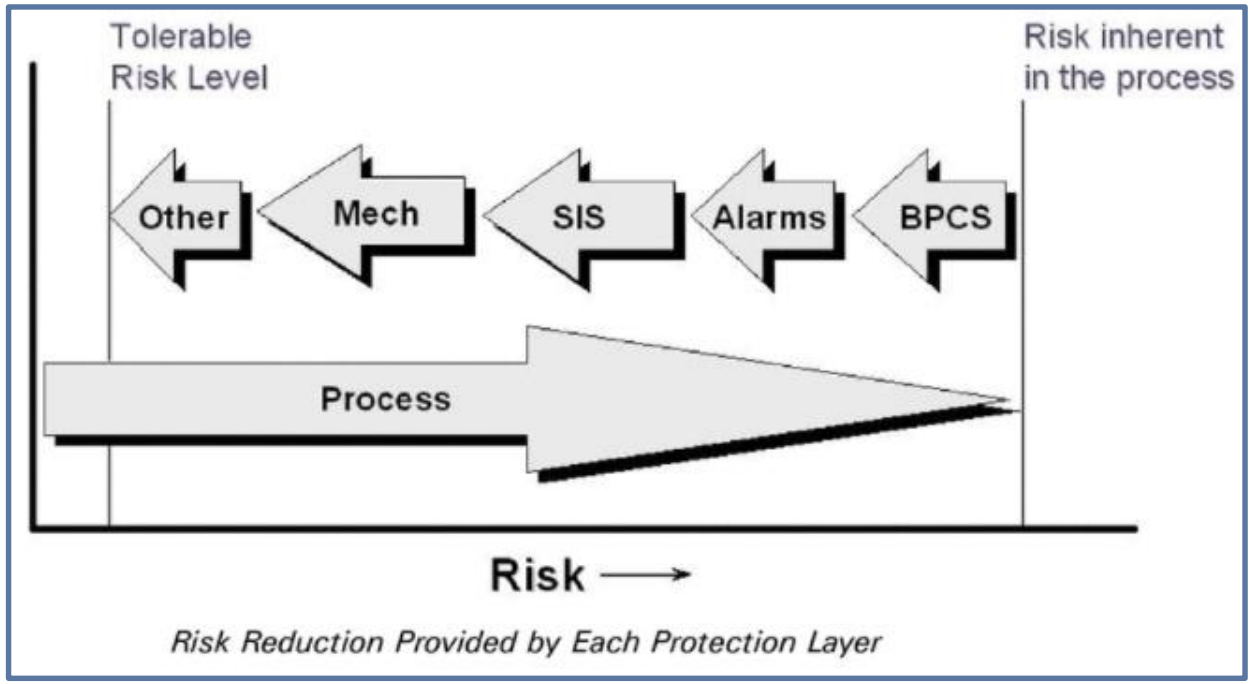
What are Abnormal Situations?

Abnormal situations are undesired plant disturbances or incidents with which the control system is not able to cope, requiring a human to intervene to supplement the actions of the control system.

Layers of Protection for Abnormal Situation

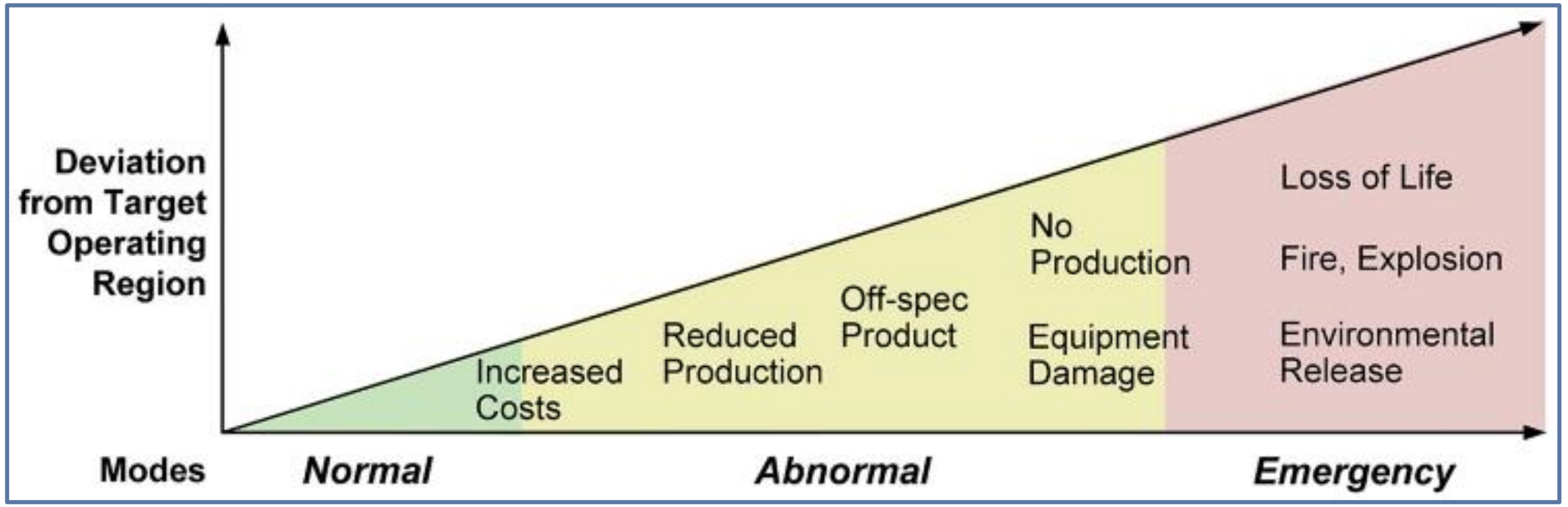


Multiple Independent Protection Layers



Risk Reduction Provided by Each Protection Layer

Evolution of an Abnormal Situation



ASM Guidelines Category

No.	ASM Guidelines Category
1.	Display Types
2.	Display Content and Task-appropriate Information
3.	Display Style
4.	Display Layout
5.	Navigation
6.	Use of Colour
7.	Use of Symbols and Process Connections
8.	Use of Text and Numbers

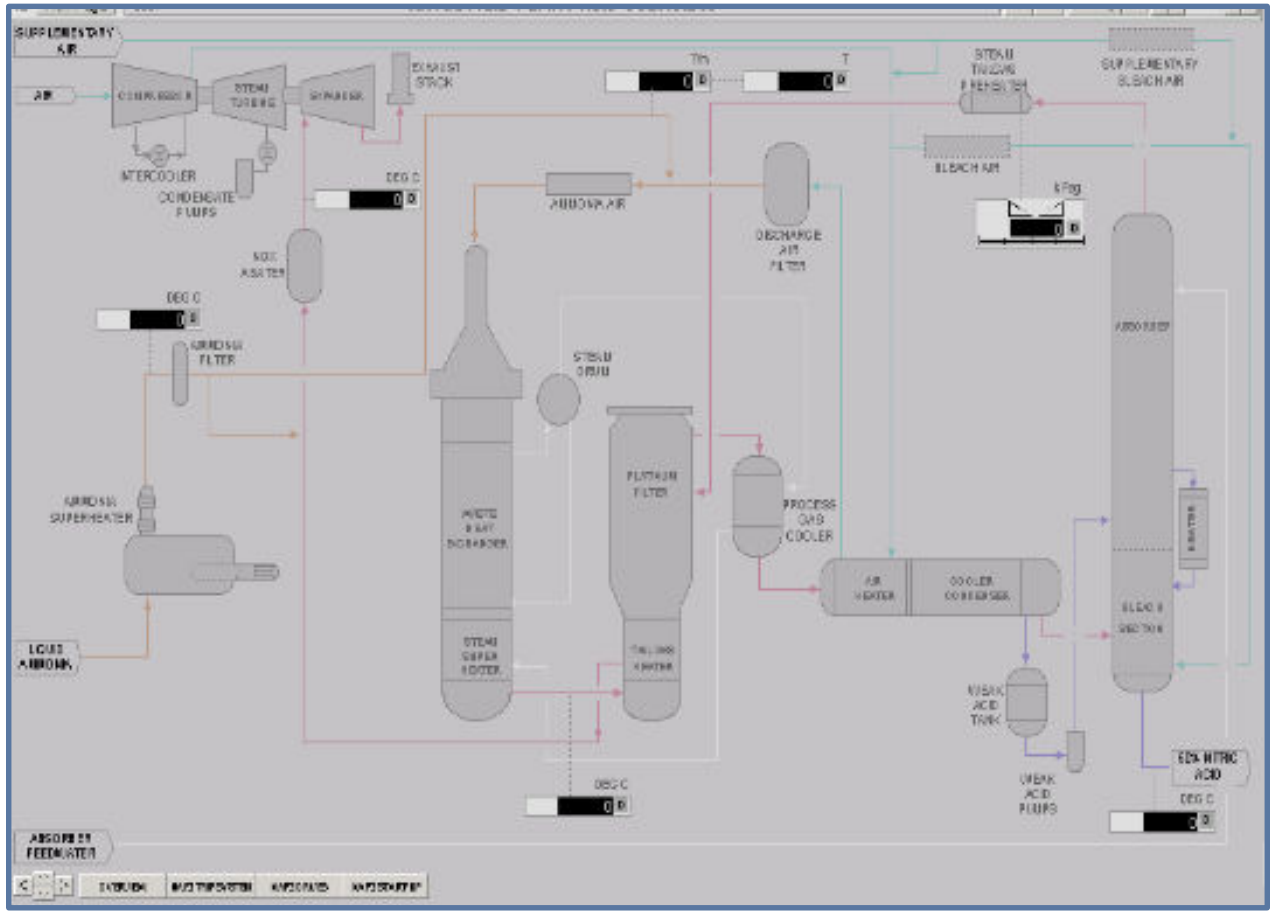
No.	ASM Guidelines Category
9.	Interactions with Displays
10.	Alarm Configuration Scheme
11.	Audible Annunciation of Alarms
12.	Visual Annunciation of Alarms
13.	Training Program
14.	Online User Assistance
15.	Design Methodology
16.	Management of Change

ASM Guideline – Display Types

No.	Display Type Guideline
1.	Use process overview display
2.	Use standard display hierarchy to represent the multi-level views necessary for monitoring and control.
3.	Use multi-level views based on the process equipment hierarchy for monitoring and control.
4.	Use multi-level views based on important functional relations for monitoring and control.
5.	Use dedicated displays to support response to critical upset conditions.

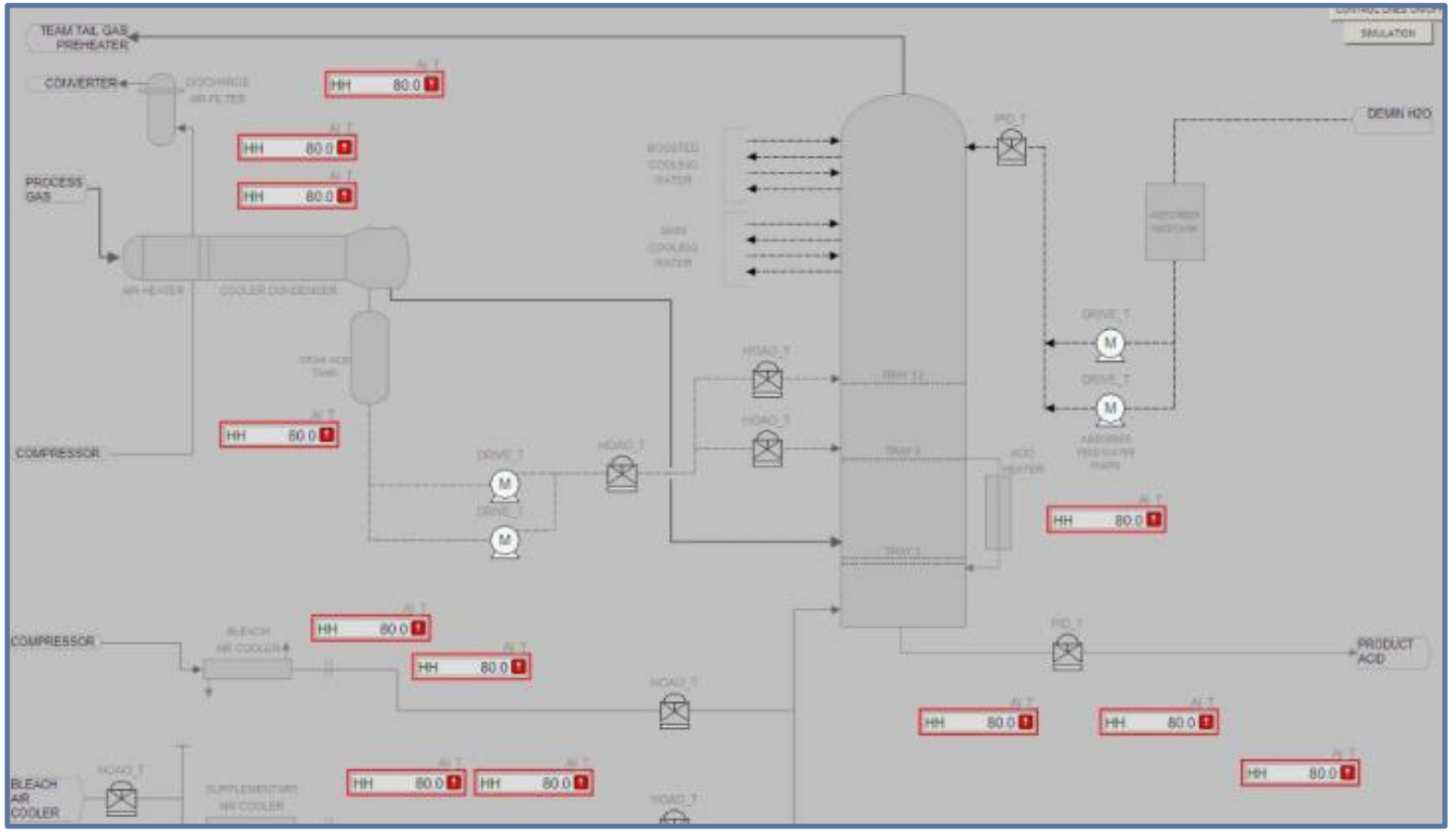
ASM Guideline – Display Types

Use process overview display



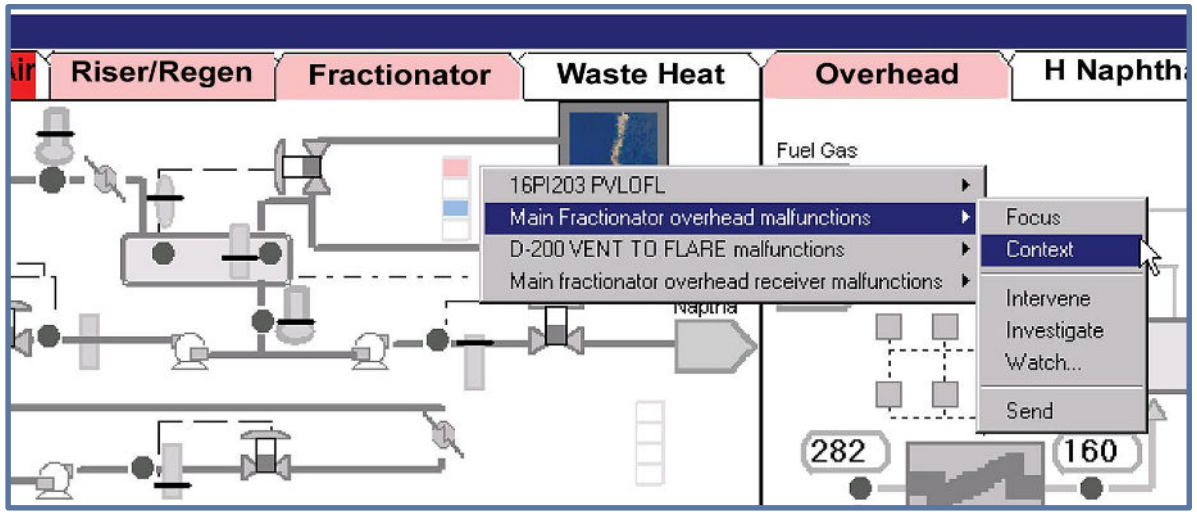
ASM Guideline – Display Types

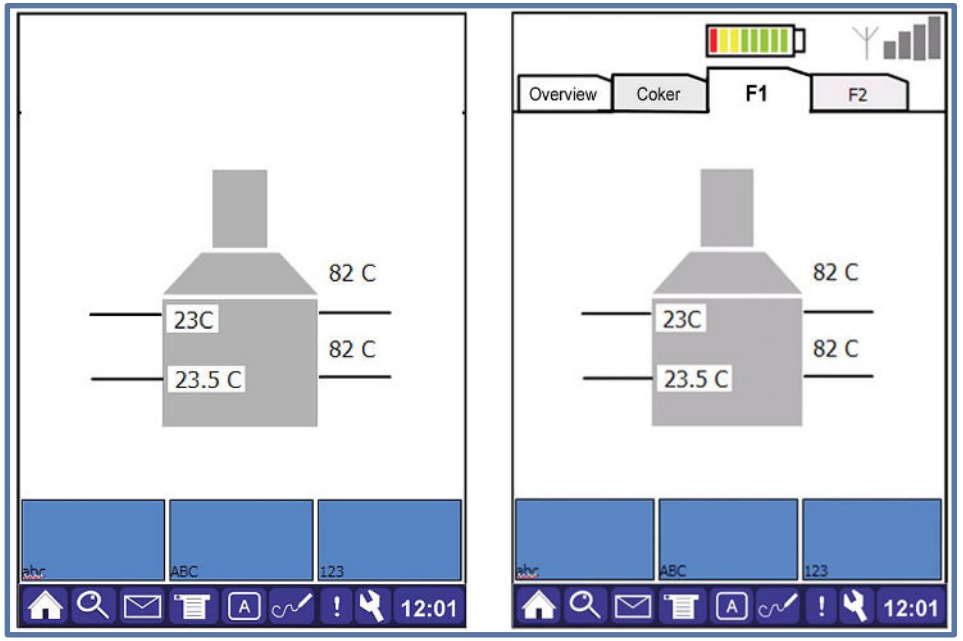
Use dedicated displays to support routine activities



ASM Guideline – Display Content Guideline

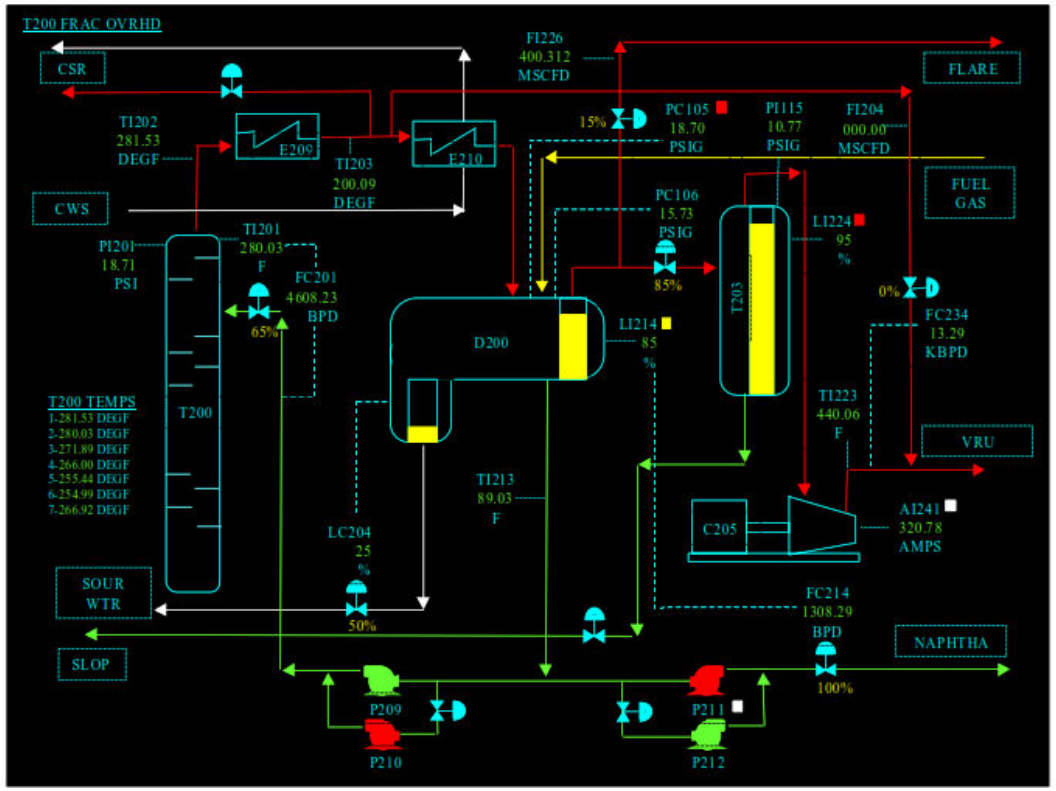
Use context-sensitive techniques to access information that is conditionally relevant

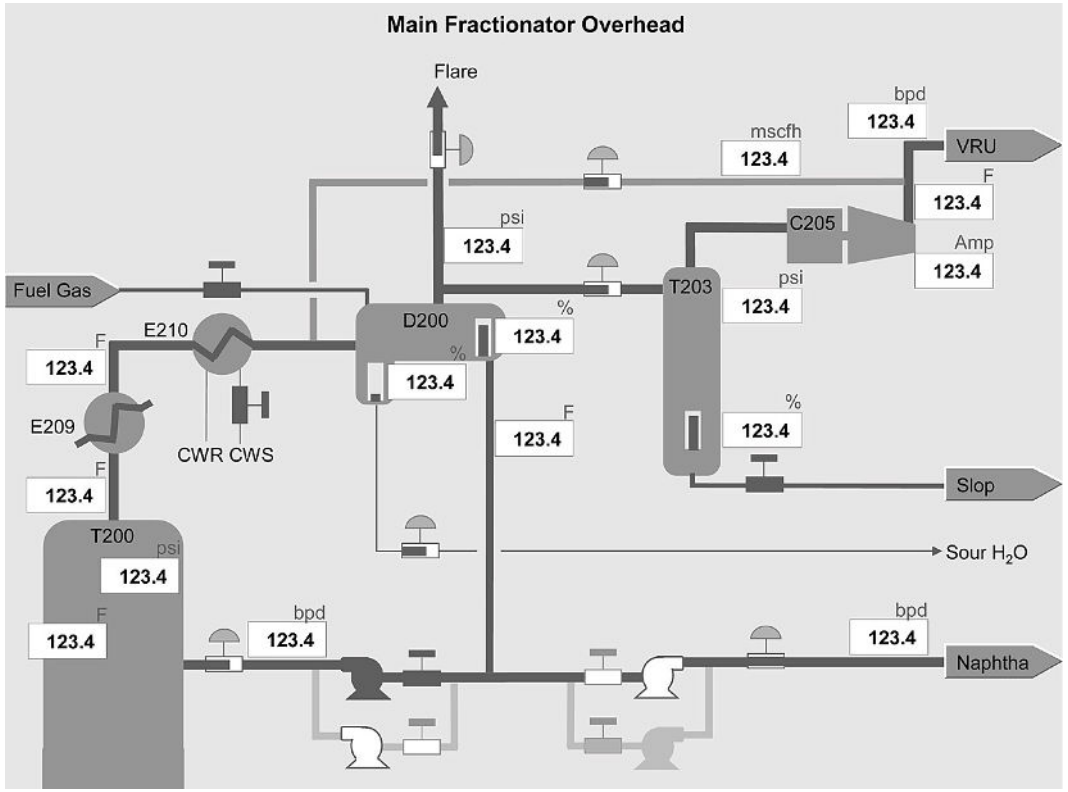




ASM Guideline – Display Style

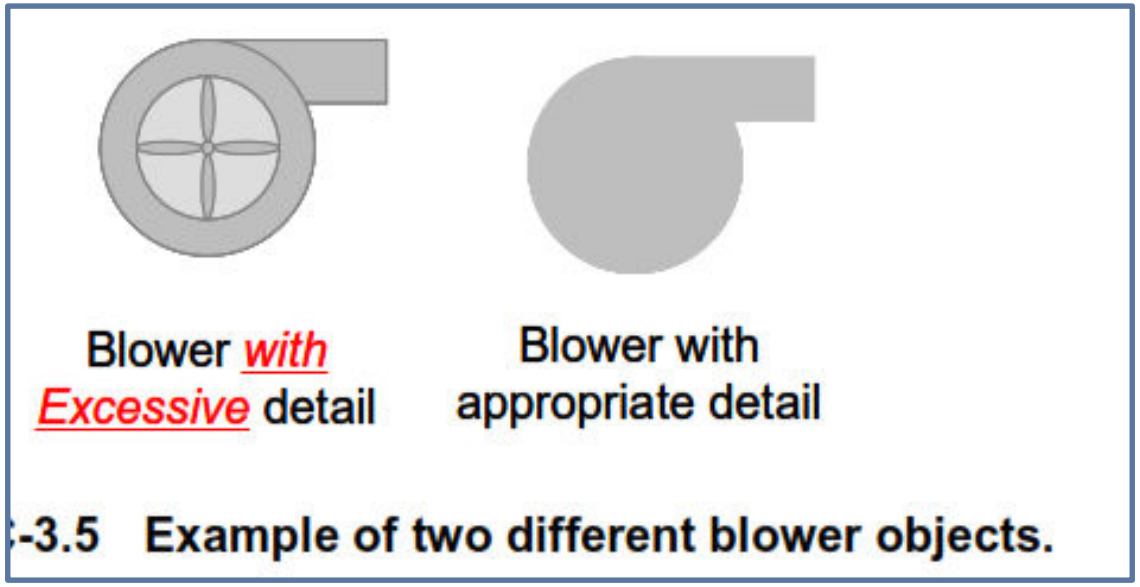
Ensure that the overall style incorporates an effective use of half-intensity background.

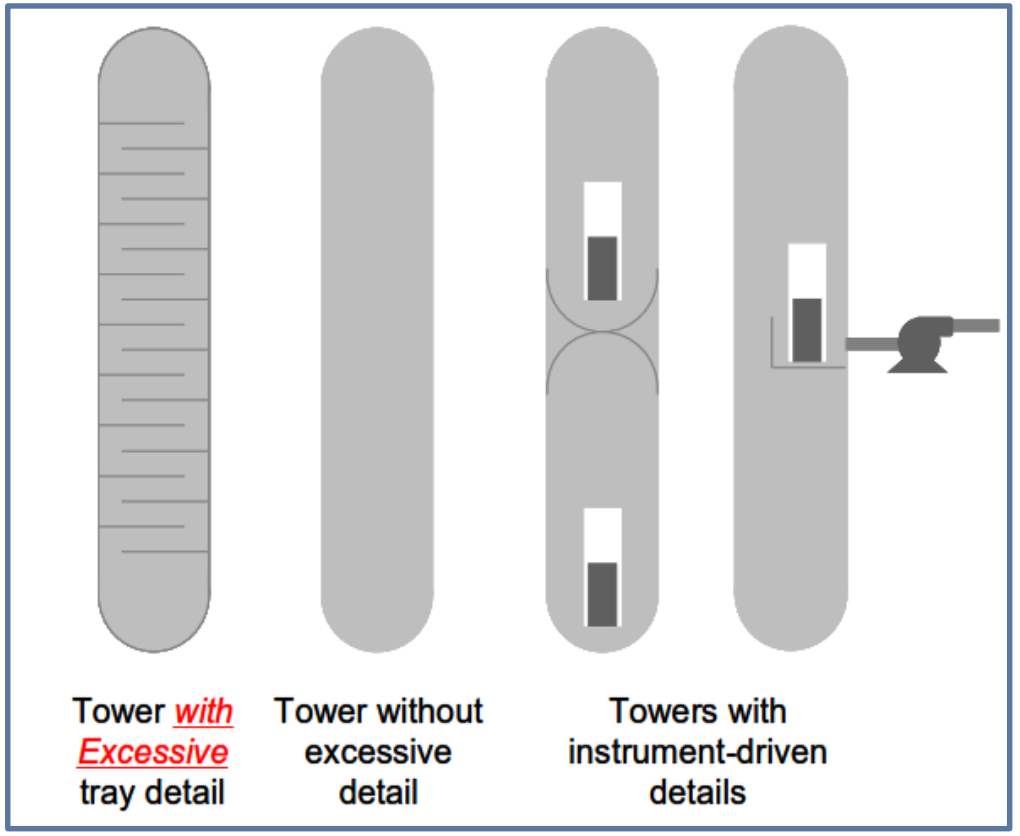




ASM Guideline – Display Style

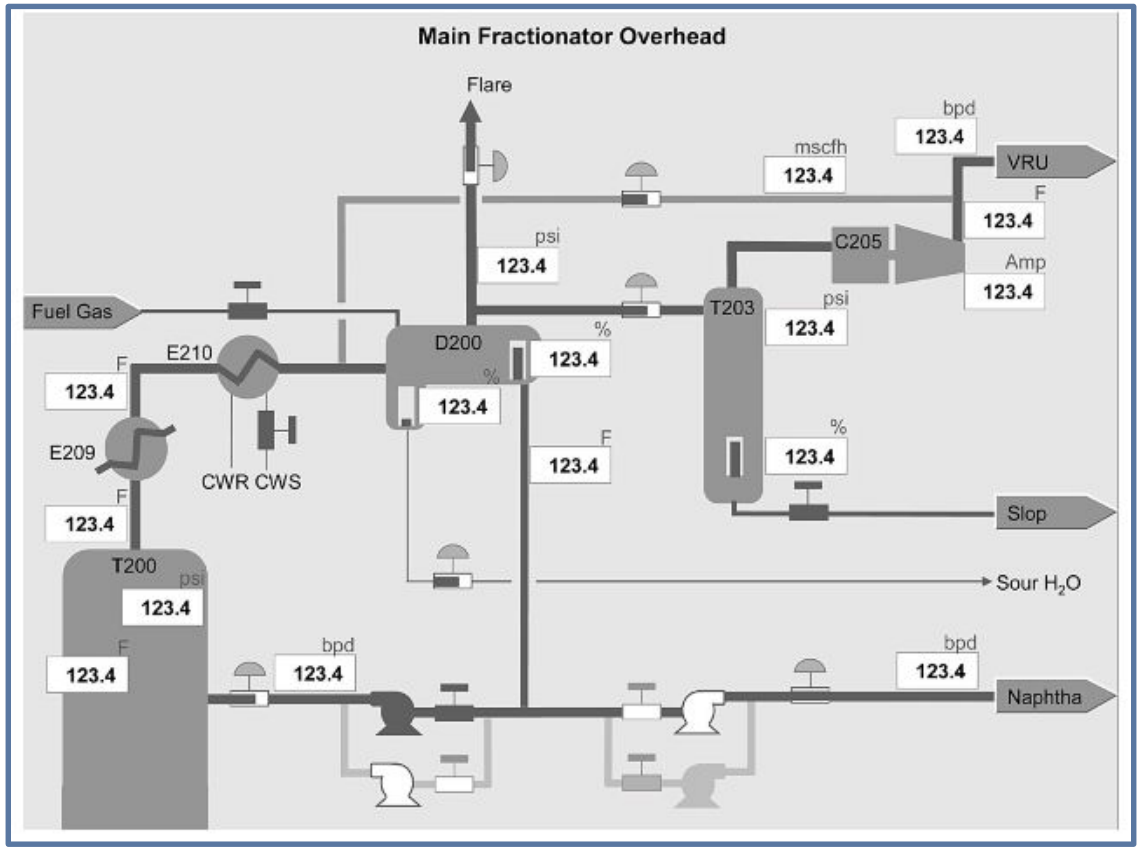
Depict equipment without excessive detail to facilitate quick identification.





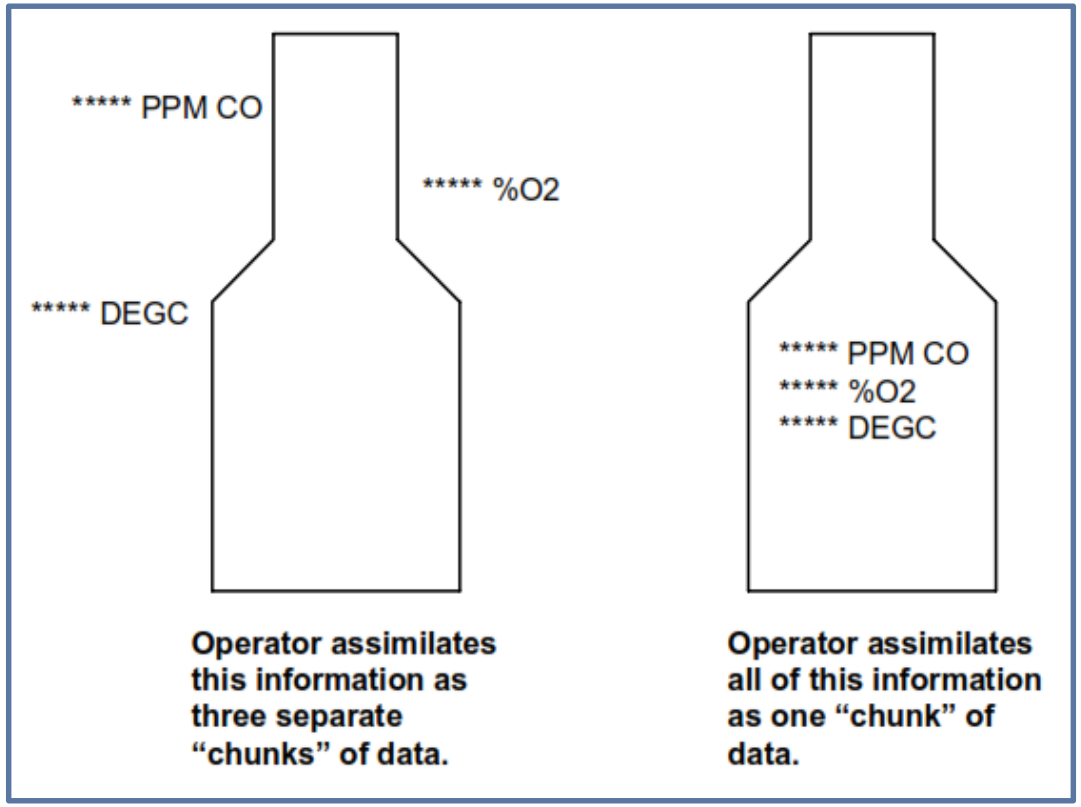
ASM Guideline – Display Layout

Develop consistent display layouts that are appropriate to process behaviours with consistent direction of flow



ASM Guideline – Display Layout

Ensure that layouts capitalize on maximizing operator retention of information in short-term memory.



ASM Guideline – Navigation

Ensure that the navigation scheme is fairly simple and flat.

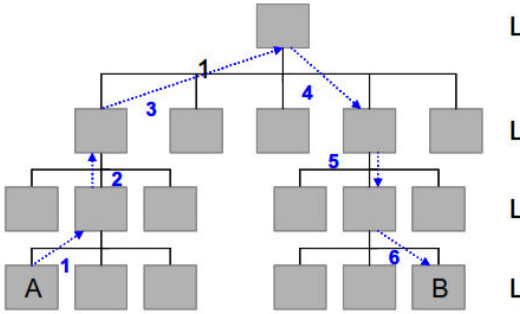


Figure C-5.1(a) A strict drill-down and –up from the current display. Six (6) operator actions are required to move from A to B. Blue lines indicate number of mouse clicks to navigate from A to B.

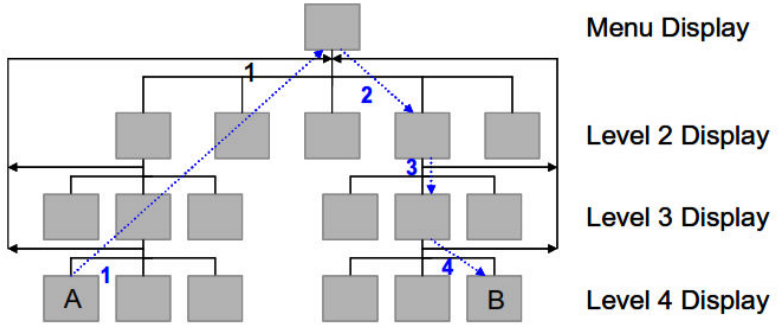
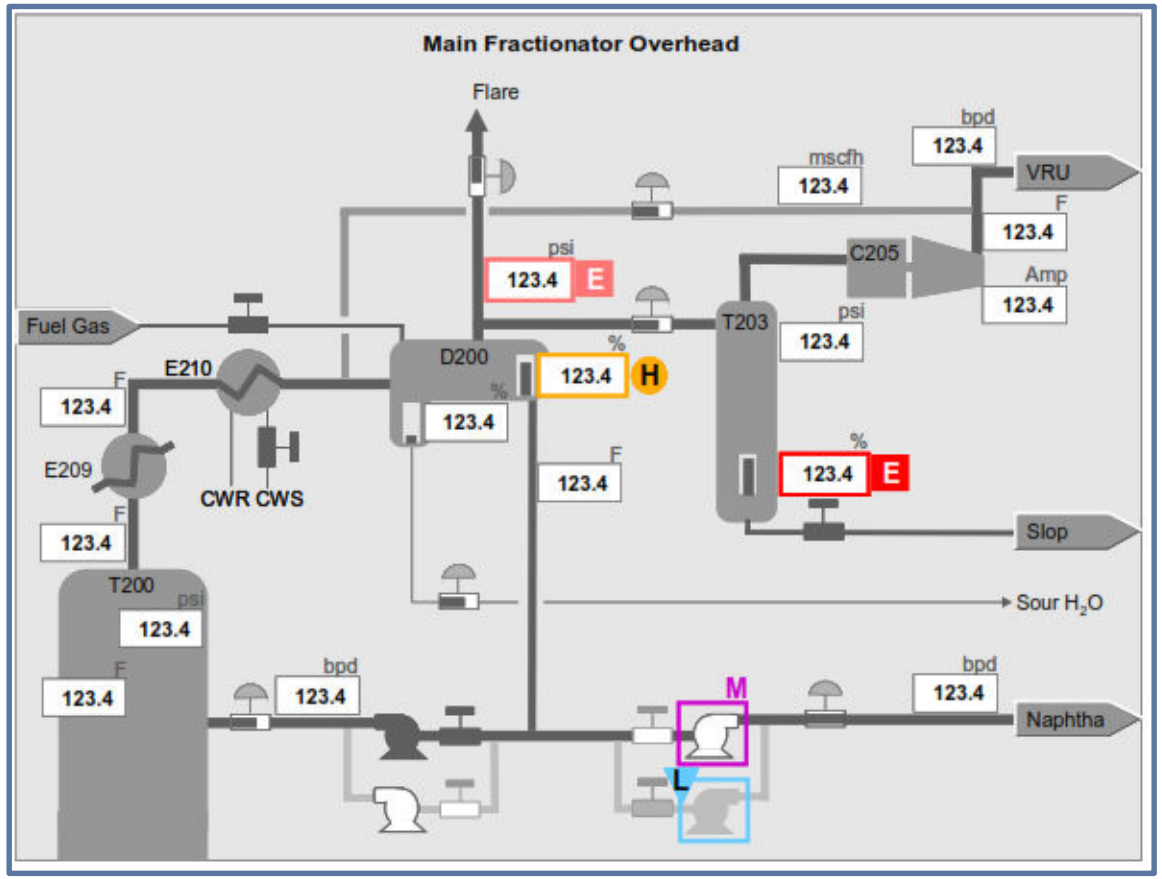
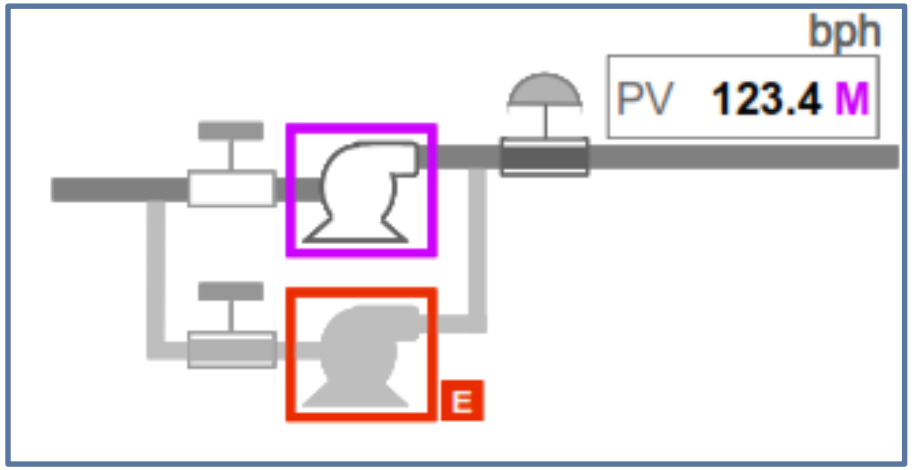


Figure C-5.1(b) A drill-down with direct access to the top menu display. Four (4) operator actions are required to move from A to B. Blue lines indicate number of mouse clicks to navigate from A to B.

ASM Guideline – Use of Colour

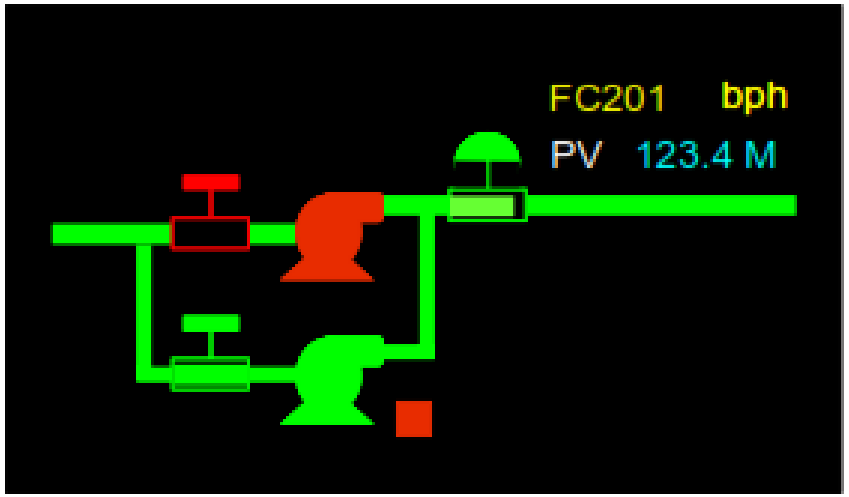
Use a minimum of colour codes consistently across the displays.



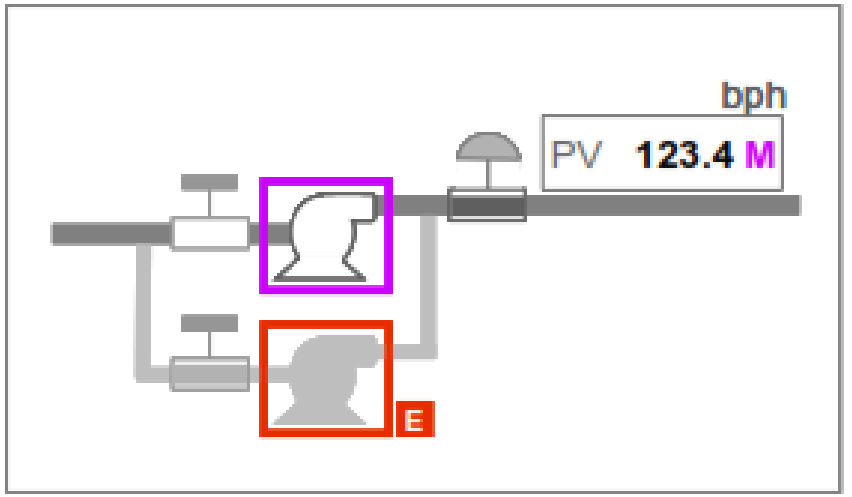


ASM Guideline – Navigation

Use brightness coding sparingly for salience coding.



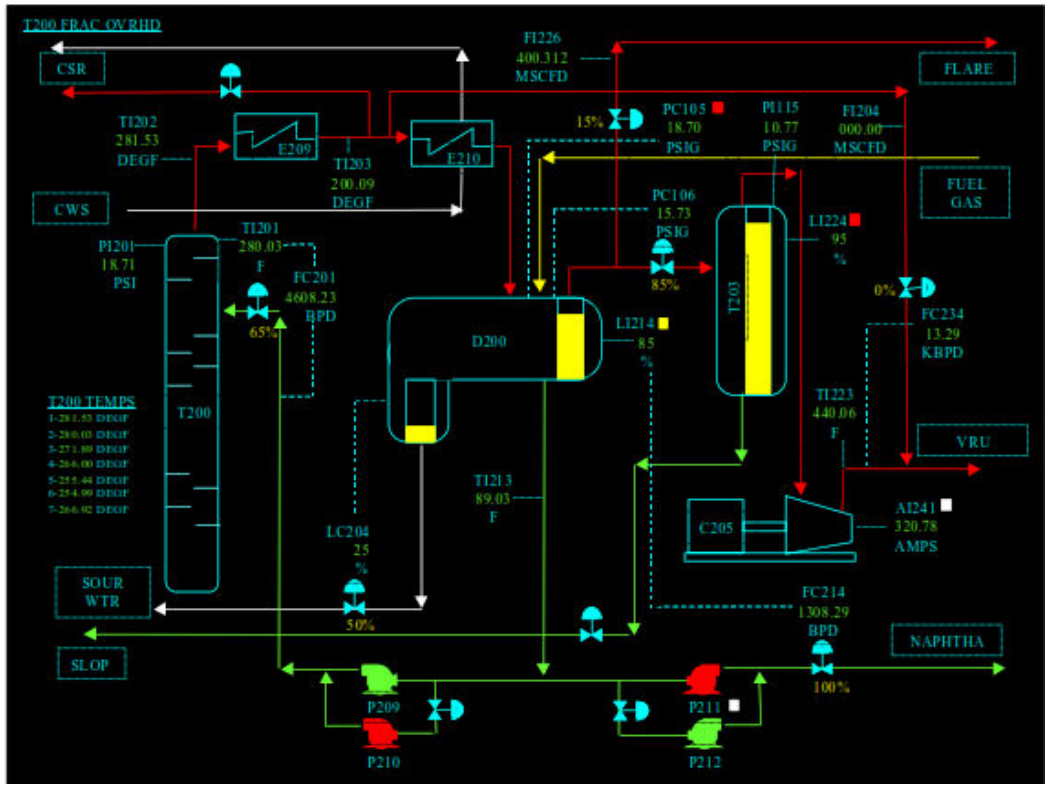
What *NOT* to Do

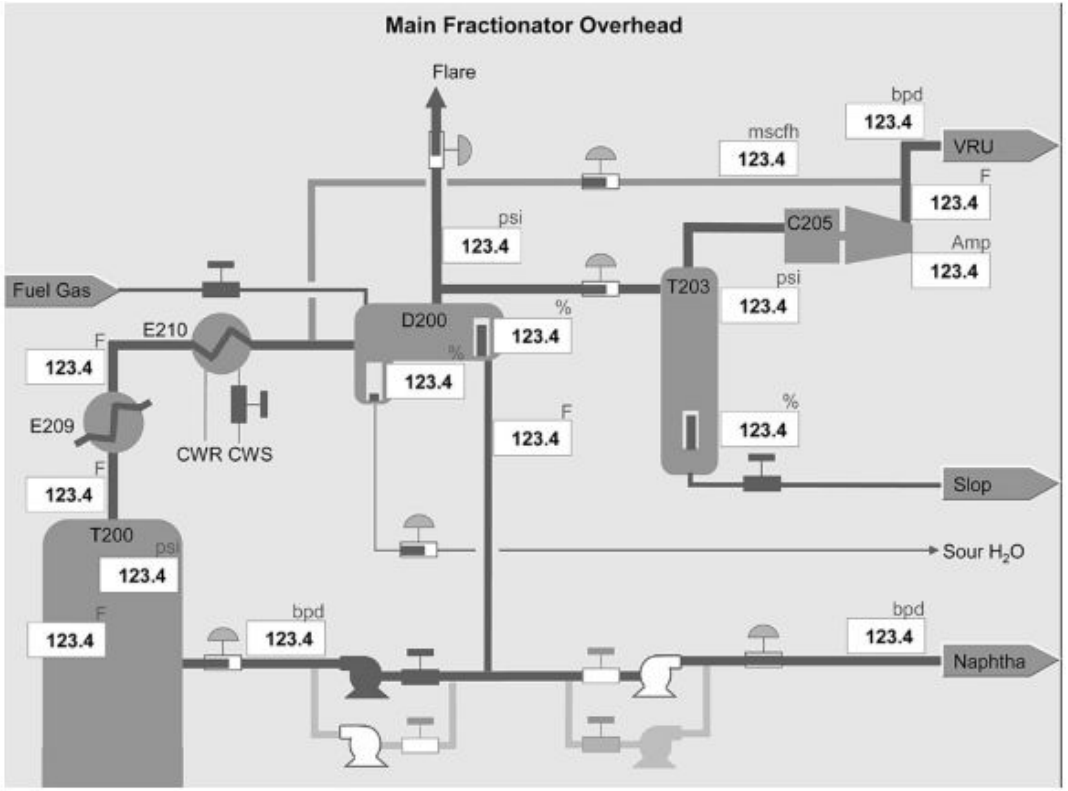


What to Do

ASM Guideline – Use of Symbols and Process Connections

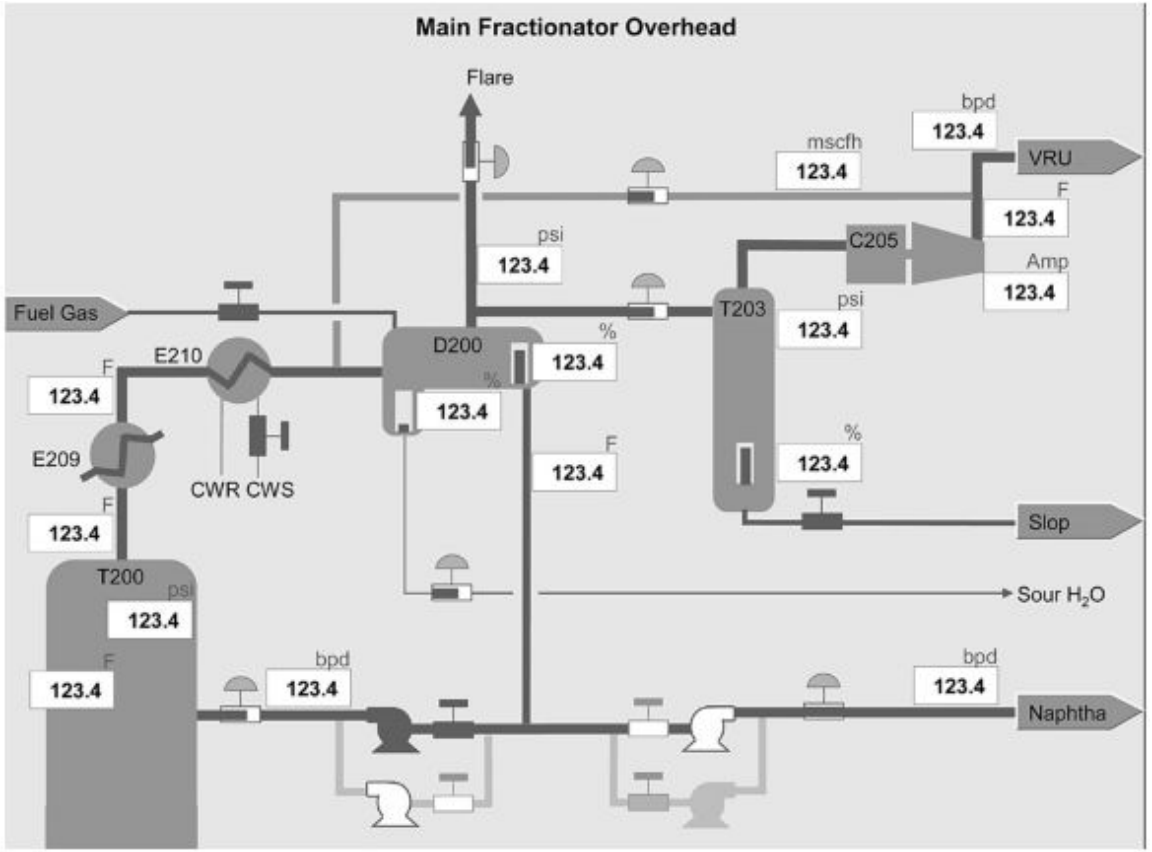
Use symbol and line coding that is easily understood with appropriate salience.





ASM Guideline – Use of Symbols and Process Connections

Having a simple and consistent set of symbols can eliminate confusion and operator error.



ASM Guideline – Use of Text and Numbers

Use text and numbers that are legible for the user's typical position.

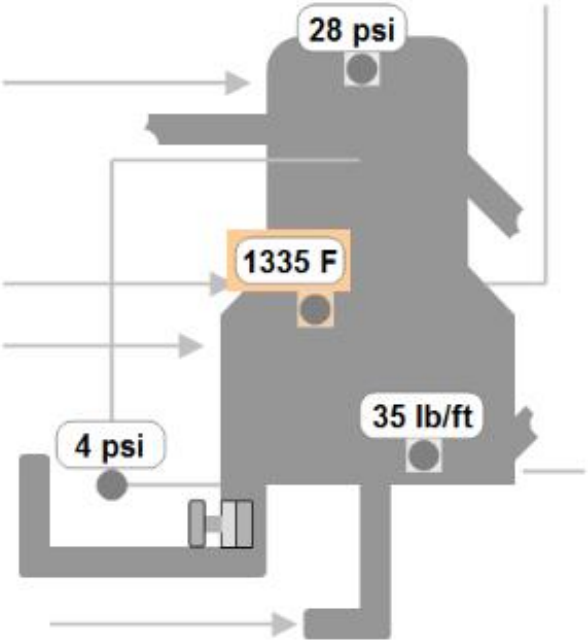
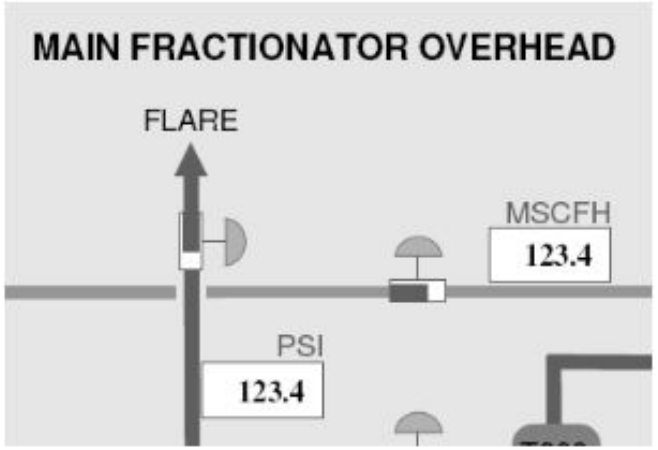
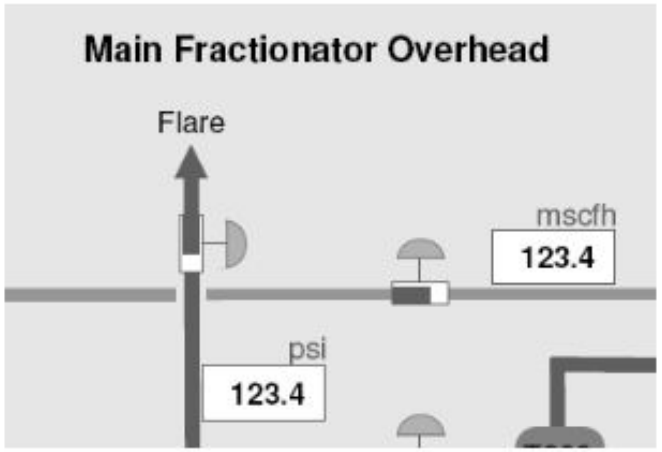


Figure C-8.2 Black text on a white background and san serif font make process values very readable.

ASM Guideline – Use of Text and Numbers

Use mixed-case lettering for text messages.

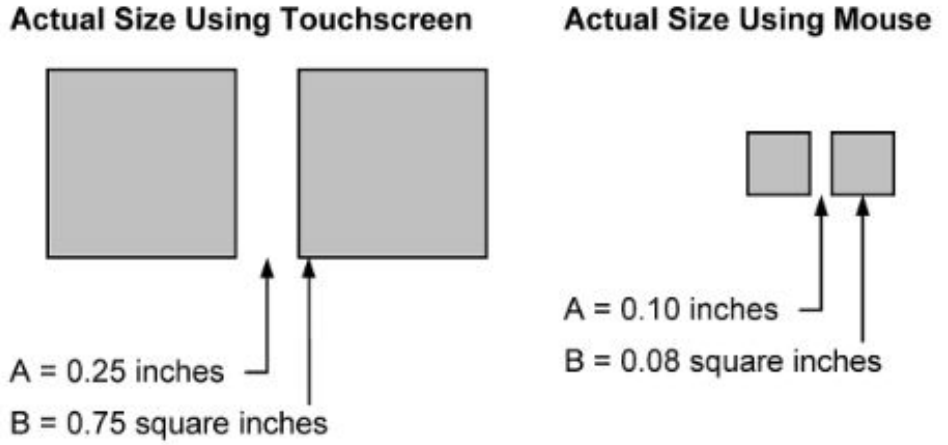




ASM Guideline – Interactions with Displays

Ensure that the size and distance between selectable display objects is appropriate to the precision enabled by the pointing device.

Minimum Value	Touch-screen	Mouse
Separation distance	0.25 in	0.10 in
Selection area	0.75 sq in	0.08 sq in



A = Minimum Separation Distance Between Selectable Objects
B = Minimum Area of Selectable Object

ASM Guideline – Interactions with Displays

Ensure that an auditory indication is given when an invalid entry is detected when error avoidance techniques are applied.

ASM Guideline – Alarm Configuration Scheme

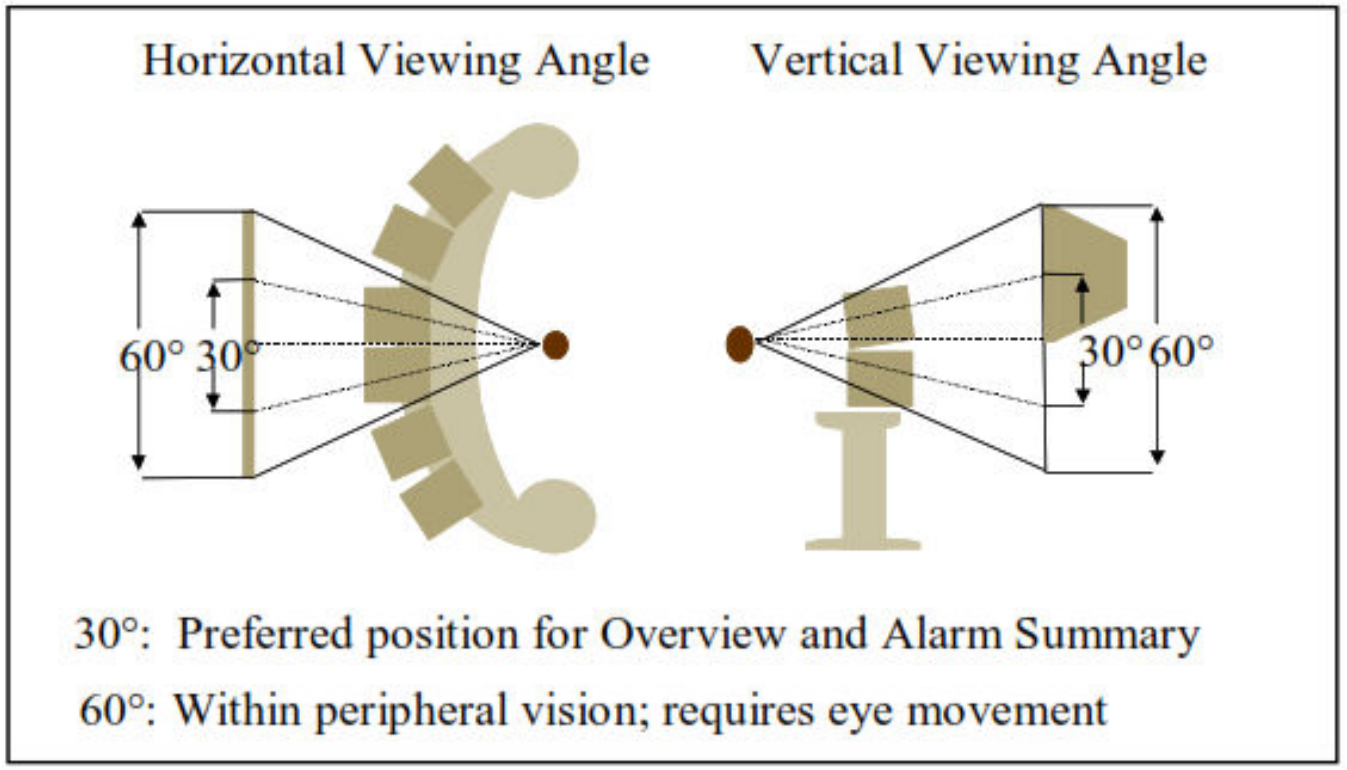
1. Ensure that displays are available to view disabled and inhibited alarms.
2. Provide information on alarm configuration settings that deviate from the designed values.
3. Provide access to alarm rationalization information.

ASM Guideline – Audible Annunciation of Alarms

1. Ensure alarms have the appropriate intensity to be audible.
2. Have a priority-based, audible bypass for upset conditions.
3. Have distinctive tones for priority

ASM Guideline – Visual Annunciation of Alarms

Ensure that critical information, such as the alarm summary process overview, is within a 30-degree maximum angle on the horizontal plane.



Conclusion

1. Ensure that all operators receive training on the display modifications
2. Ensure that simulation-based training is provided for task-specific learning: upset management, start-up, and shutdown
3. Ensure that operators are involved in development activities
4. Ensure that Management Of Change captures changes in design of operator displays.

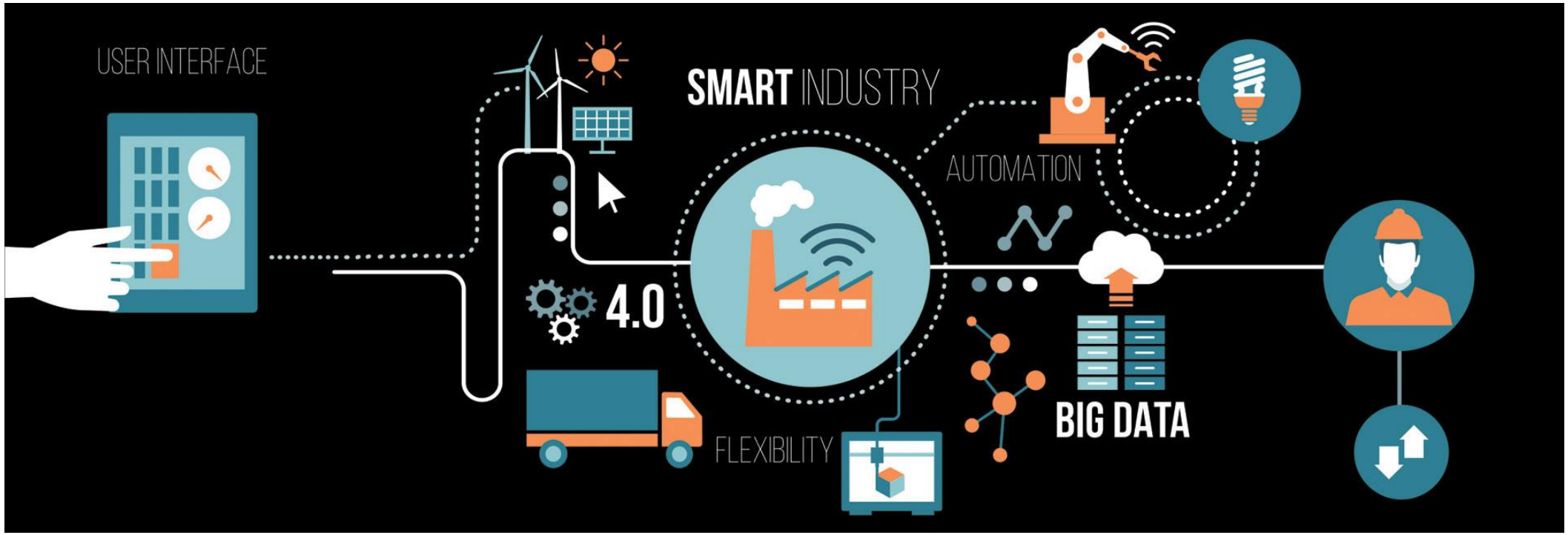
The implementation of an individual guideline in itself will not guarantee improved effective operations practices, but together, all of the guidelines will form an integrated program leading to improvements.

Reference list

- A guide to the Automation Book of Knowledge Second Edition 2006.
- Effective Operator Display Design. Copyright © 2008 by Honeywell International Inc. Published by the ASM® Consortium.
- Honeywell Experion PKS HMIWeb Solution Pack Shapes, Example Display

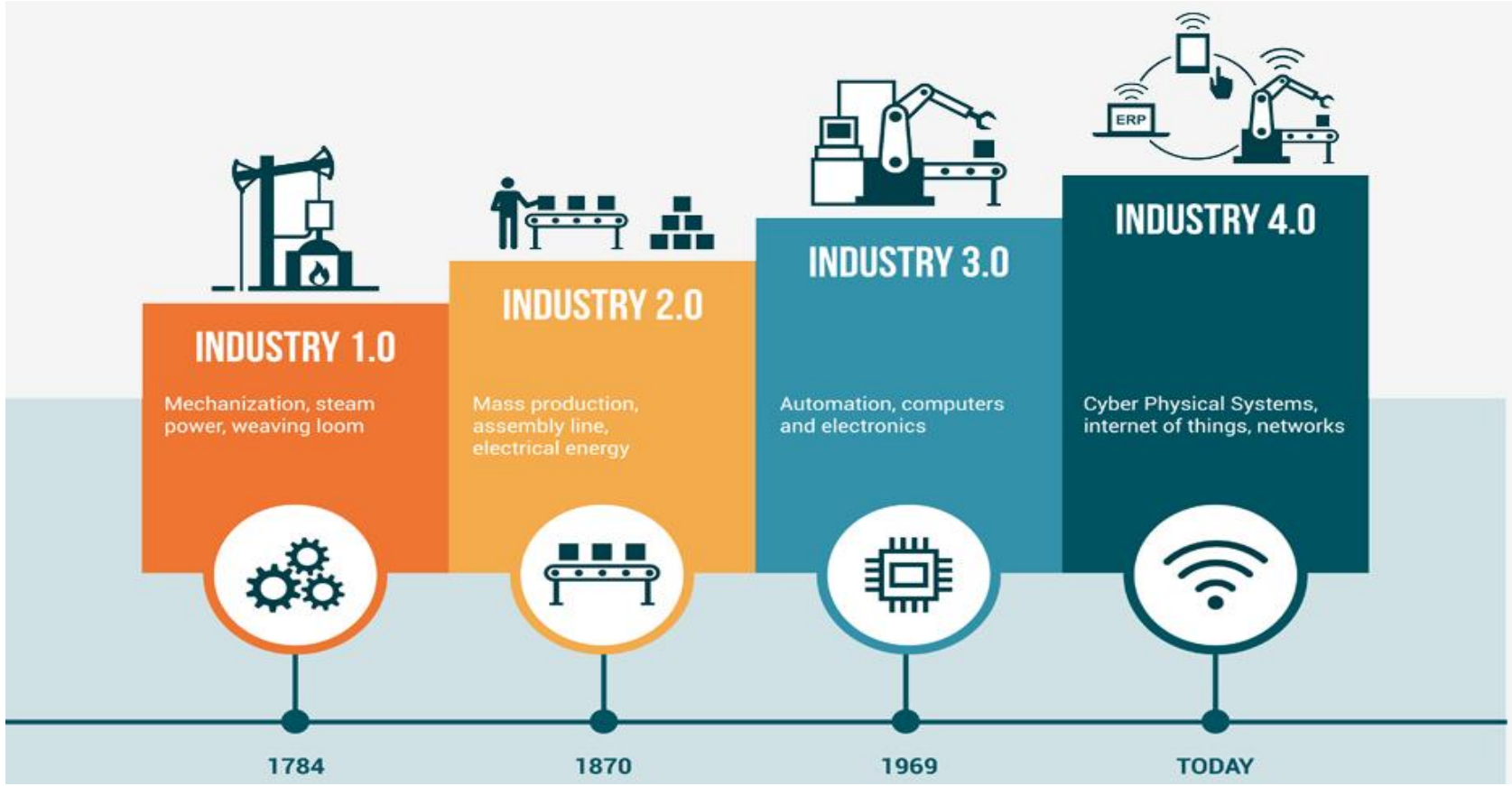
What is Industrial Automation Field?

Industrial Automation (IA) is the use of control systems, such as computers or robots, and information technologies for handling different processes and machineries in an industry to assist a human being and takeover their responsibilities.



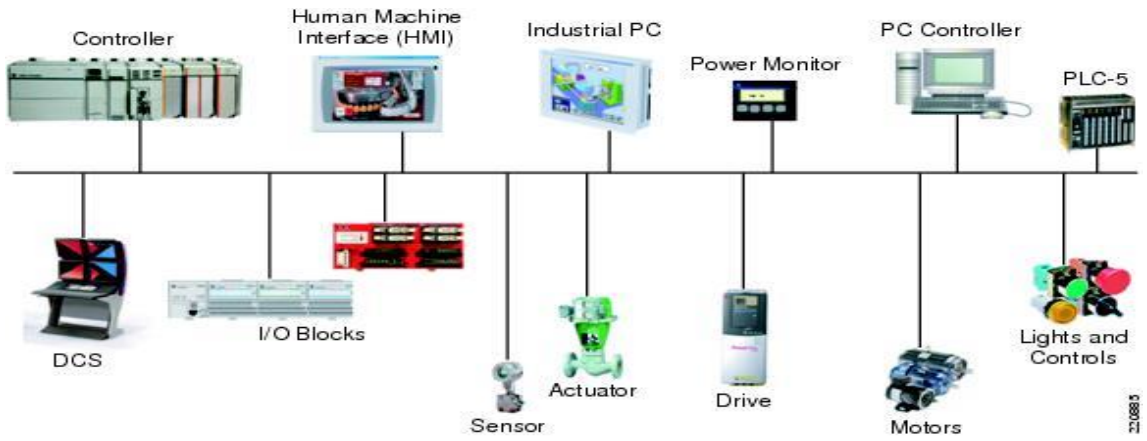
What is Industrial Automation Field?

Industrial Automation (IA) is the second step beyond mechanization in the scope of industrialization.



What is Industrial Automation Field?

1.



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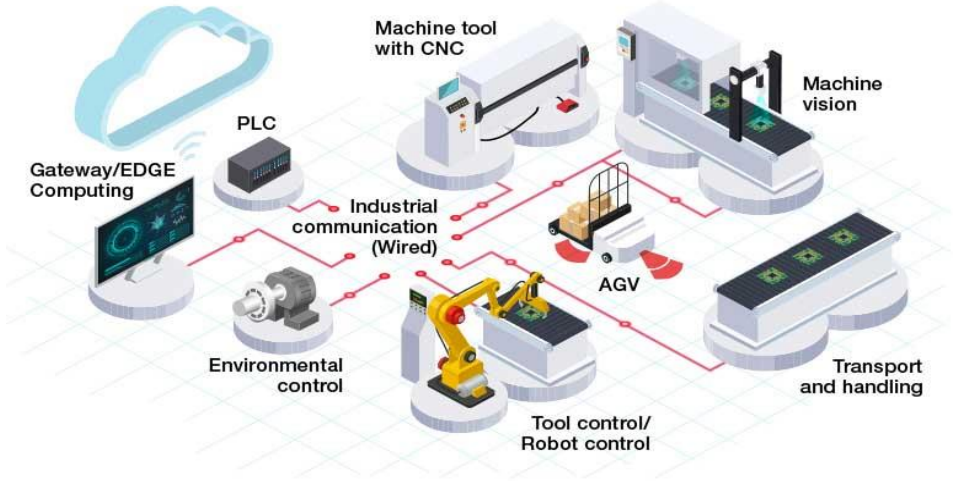

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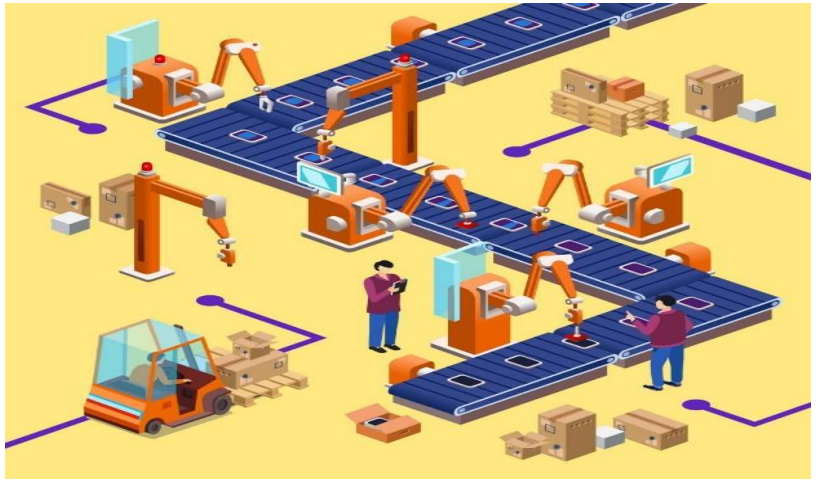

What is Industrial Automation Field?

What might someone working in the field do on a daily basis?

Industrial Automation branches (broad):

- Manufacturing Engineering
- Power-plant Engineering
- Mechatronics/Robotics Engineering
- Industrial Engineering
- Control Engineering
- Mechanical Engineering
- Electrical Engineering
- Process Engineering
- Industrial Communication
- Chemical Engineering
- Oil and Gas Instrumentation

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Advanced Diploma of Industrial Automation Engineering

Module	Module/ Unit Name	Duration
1	Instrumentation for Automation and Process Control (DIAIAP601)	4 Weeks
2	Use basic mathematics in engineering (DCSBME604)	6 Weeks
3	Fundamentals of Chemical Engineering (for Non-Chemical Engineers) (DIAFCE603)	2 Weeks
4	Control Valve Sizing, Selection and Maintenance (DIACVS604)	2 Weeks
5	Process Plant Layout and Piping Design (DIAPPL605)	3 Weeks
6	Apply the fundamentals of professional engineering practice (DPEFPE619)	4 Weeks
7	Process Control and Tuning of Industrial Control Loops (DIAPCT607)	5 Weeks
8	Best Practice Industrial Data Communications (DIAIDC608)	6 Weeks
9	Distributed Control Systems (DIADCS609)	4 Weeks
10	Programmable Logic Controllers (DIAPLC610)	3 Weeks

Advanced Diploma of Industrial Automation Engineering (cont.)

Module	Module/ Unit Name	Duration
11	Advanced Process Control and Boiler Control (DIAPCB611)	5 Weeks
12	Hazardous Areas and Hazops (DIAHAZ612)	5 Weeks
13	Safety Instrumentation and Shutdown Systems (DIASIS613)	3 Weeks
14	Printed Circuit Board Design Issues (DIAPCB614)	2 Weeks
15	Wireless Ethernet and TCP/IP Networking (DIAWEN615)	3 Weeks
16	Radio Telemetry Systems (DIARTS616)	3 Weeks
17	SCADA Systems (DIASCA617)	3 Weeks
18	IoT Systems (DIAIOT618)	2 Weeks
19	Motor Protection, Control and Maintenance Technologies (DIAMPC619)	3 Weeks
20	Power Distribution (DIAPDI620)	4 Weeks

For more information about the course, visit our website: www.eit.edu.au/courses/advanced-diploma-of-industrial-automation/

Bachelor of Science (Industrial Automation Engineering)

Year One

Semester	Unit Code	Subject	Credit Points
Semester 1	BSC101C	Engineering Mathematics 1 (Core)	3
Semester 1	BSC102C	Electrical Circuit Theory and Analysis (Core)	3
Semester 1	BSC103C	Engineering Dynamics + Mechanics (Core)	3
Semester 1	BSC203C	Engineering Design and Drawing (Core)	3
Semester 1	BSC109C (Part A)	Industrial Experience Research Project	0
Semester 2	BSC104C	Engineering Mathematics 2 (Core)	3
Semester 2	BSC201C	Engineering Programming (Core)	3
Semester 2	BIA106S	Principles of Chemical Engineering	3
Semester 2	BSC107C	Physics and Chemistry for Engineers (Core)	3
Semester 2	BSC109C (Part B)	Industrial Experience Research Project	3
Holiday	BSC110C	Industrial Experience	0

Bachelor of Science (Industrial Automation Engineering)

Year Two

Semester	Unit Code	Subject	Credit Points
Semester 1	BIA108S	Process Instrumentation and Control	3
Semester 1	BSC105C	Mechanics of Machines (Core)	3
Semester 1	BSC202C	Engineering Mathematics 3 (Core)	3
Semester 1	BIA205S	Electrical Control Circuits and PLC Programming	3
Semester 1	BSC302C (Part A)	Project Planning, Management and Costing (Core)	0
Semester 2	BIA204S	Ancillary Support Systems	3
Semester 2	BIA206S	Communications and Networks	3
Semester 2	BIA208S	Safety Systems Engineering	3
Semester 2	BIA209S	Analysis and Modelling of Dynamics Systems	3
Semester 2	BSC302C (Part B)	Project Planning, Management and Costing (Core)	3
Holiday	BSC210C	Industrial Experience	0

Bachelor of Science (Industrial Automation Engineering)

Year Three

Semester	Unit Code	Subject	Credit Points
Semester 1	BIA207S	Automation Systems and Supervisory Control	3
Semester 1	BIA301S	Communication Systems and Protocols	3
Semester 1	BIA303S	Embedded Systems Design	3
Semester 1	BIA304S	Power and Drive Controls	3
Semester 1	BSC305C (Part A)	Technology, Sustainability and Society (Core)	0
Semester 2	BIA306S	Instrument and Control Engineering Practices	3
Semester 2	BIA307C	Final Year Project (Industrial Automation Engineering)	9
Semester 2	BSC305C (Part B)	Technology, Sustainability and Society (Core)	3

For more information about the course and to view the additional mandatory units, visit our website:
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Master of Engineering (Industrial Automation)

Year One

Semester	Unit Code	Subject	Credit Points
Semester 1	ME500	Industrial Automation Introduction	3
Semester 1	ME502	Programmable Logic Controllers	3
Semester 1	ME503	Industrial Process Control Systems	3
Semester 1	ME504	Industrial Instrumentation	3
Semester 2	ME509	Electrical Engineering for Industrial Automation	3
Semester 2	MXX507	Professional Engineering Management	3
Semester 2	ME510	Industrial Data Communications	3
Semester 2	ME508	Safety Instrumentation Systems	3

Year Two

Semester	Unit Code	Subject	Credit Points
Semester 1	ME605	Machine Learning for Industrial Automation	3
Semester 1	ME602	SCADA and Distributed Control Systems	3
Semester 1	ME603	Advanced Process Control	3
Semester 1	MXX501/601	Engineering Practice and Key Research Methods	3
Semester 2	ME700	Project Thesis (taken over 1 semester)	3

For more information about the course and to view the additional mandatory units, visit our website: www.eit.edu.au/courses/on-campus-master-of-engineering-industrial-automation/

Upcoming EIT Courses – Industrial Automation

Course	Start Date
Professional Certificate of Competency in Programmable Logic Controllers (PLCs) & SCADA Systems	24/01/2022
Professional Certificate of Competency in Safety Instrumentation Systems for Process Industries	14/02/2022
Undergraduate Certificate in Industrial Automation Engineering	14/02/2022
52886WA Advanced Diploma of Industrial Automation Engineering	08/03/2022
Professional Certificate of Competency in Instrumentation, Automation and Process Control	14/03/2022
52872WA Advanced Diploma of Robotics and Mechatronics Engineering	04/04/2022
Professional Certificate of Competency in IEC 61850 based Substation Automation	16/05/2022
Graduate Certificate in Industrial Instrumentation and Safety Systems	27/06/2022
Graduate Certificate in Industrial Instrumentation and Process Control	27/06/2022
Graduate Certificate in Programmable Logic Controllers and SCADA	27/06/2022
Graduate Certificate in Industrial Automation Engineering	27/06/2022
Master of Engineering (Industrial Automation)	27/06/2022

See our full course schedule here: www.eit.edu.au/schedule/

Upcoming Webinars

Upcoming webinars: www.eit.edu.au/news-events/events/

Certificate of Attendance

To receive your digital certificate of attendance for participating in this webinar, please fill out the form and survey here (or scan the QR Code): qrco.de/bchwkq

Please note that Certificate of Attendances will be sent out in the next 1-2 business days.

SCAN ME

Q&A

Thank you for attending.

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Courses
www.eit.edu.au/schedule/