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Control of Gas-turbine driven compression

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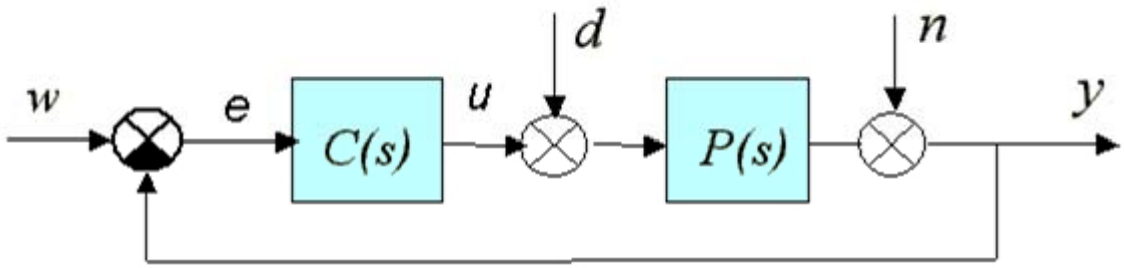
BBQ Safety

Overview

- Drivers behind control systems
- Engineered aspects of control systems
- Control system architecture
- Cyber security



Driver behind control systems

- Design system or process to have a desired performance (e.g. constant discharge pressure)

- quest for greater flexibility, efficiency, reliability, etc. have put greater performance demands on the control system

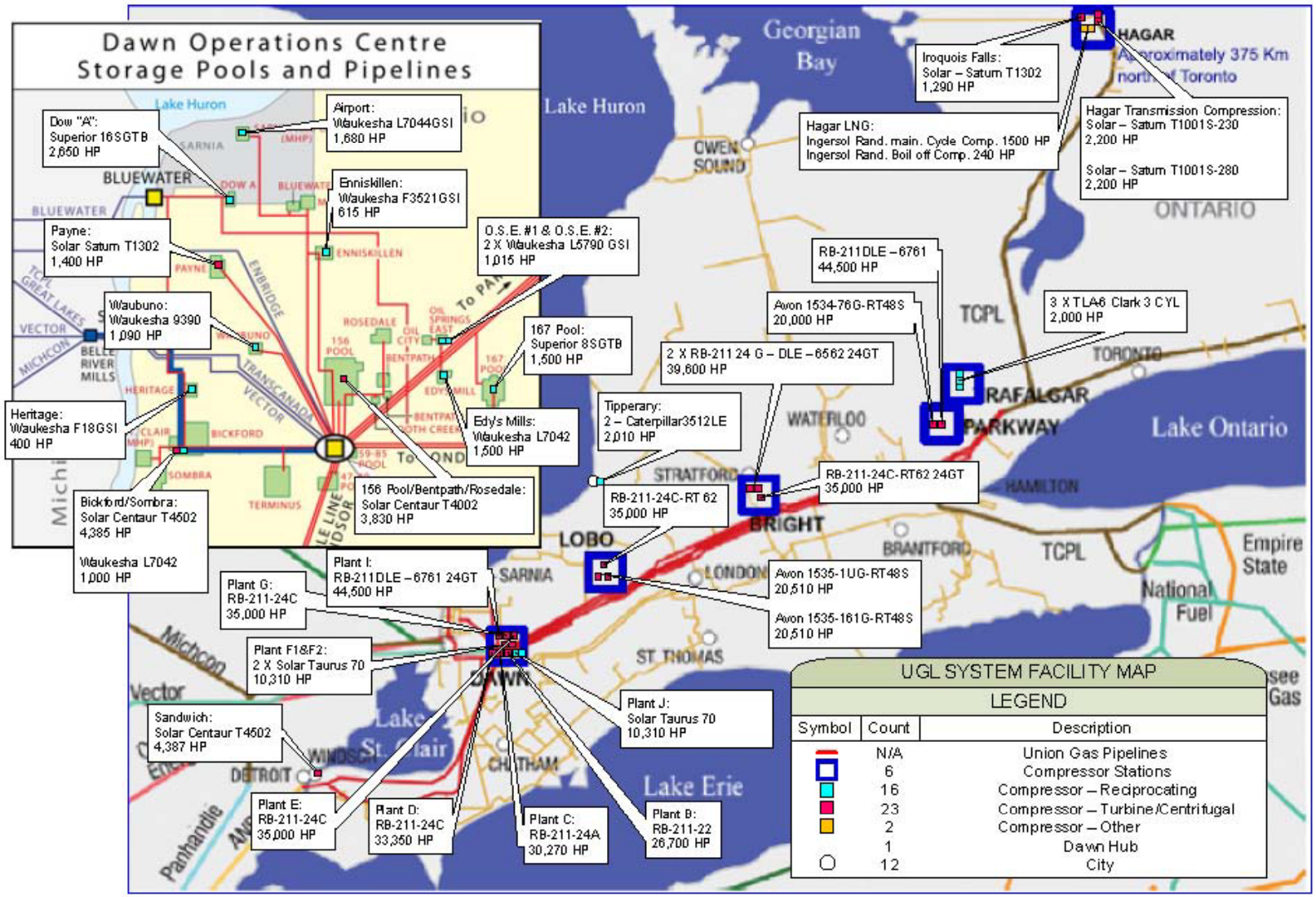
  (add: DLE and load sharing)

- Technology has enabled advanced control system solutions via programmability, improved data acquisition, faster hardware

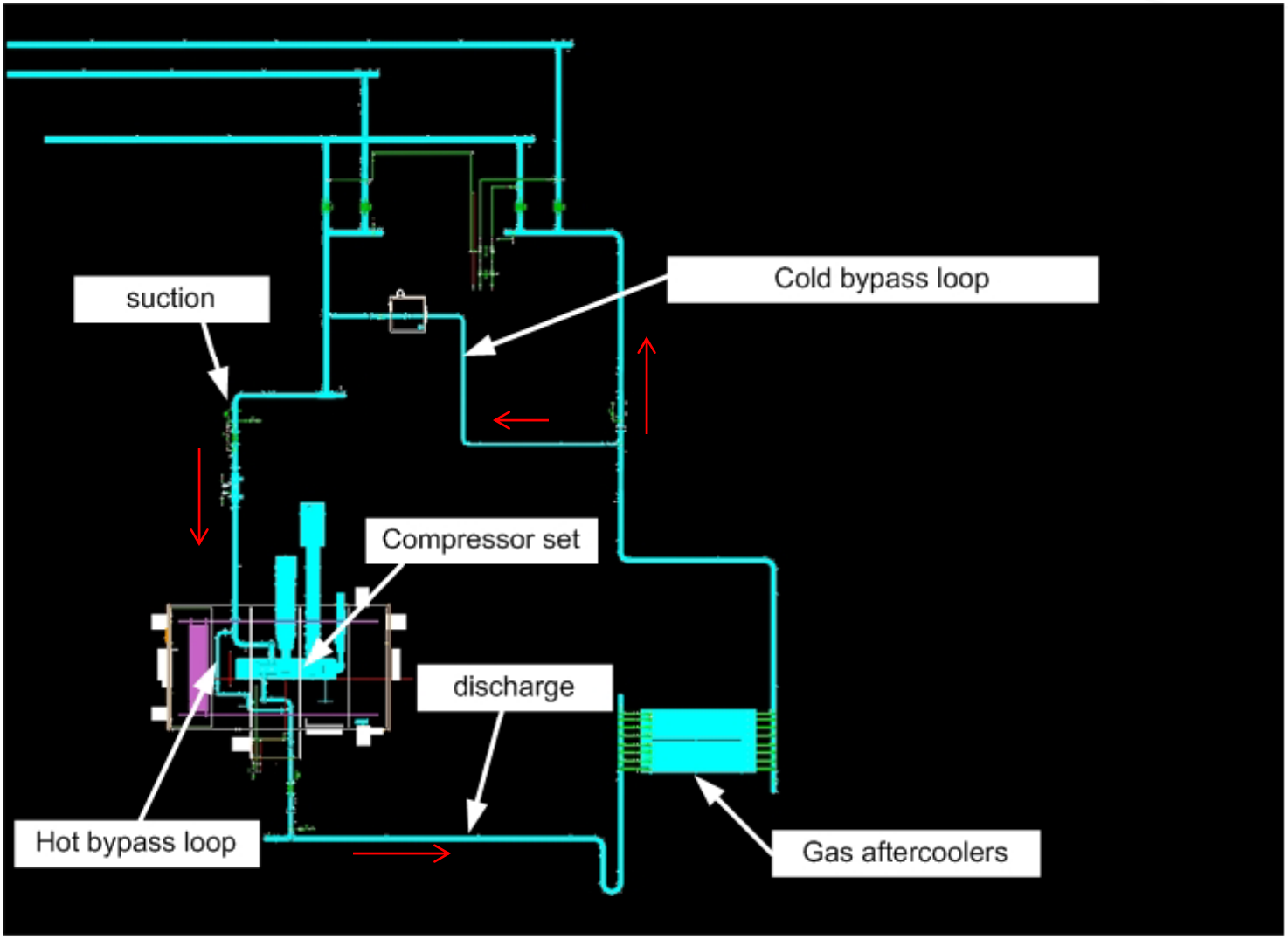
Driver behind control systems

- Automatic sequencing
- Protection
- Condition monitoring
- Remote operation

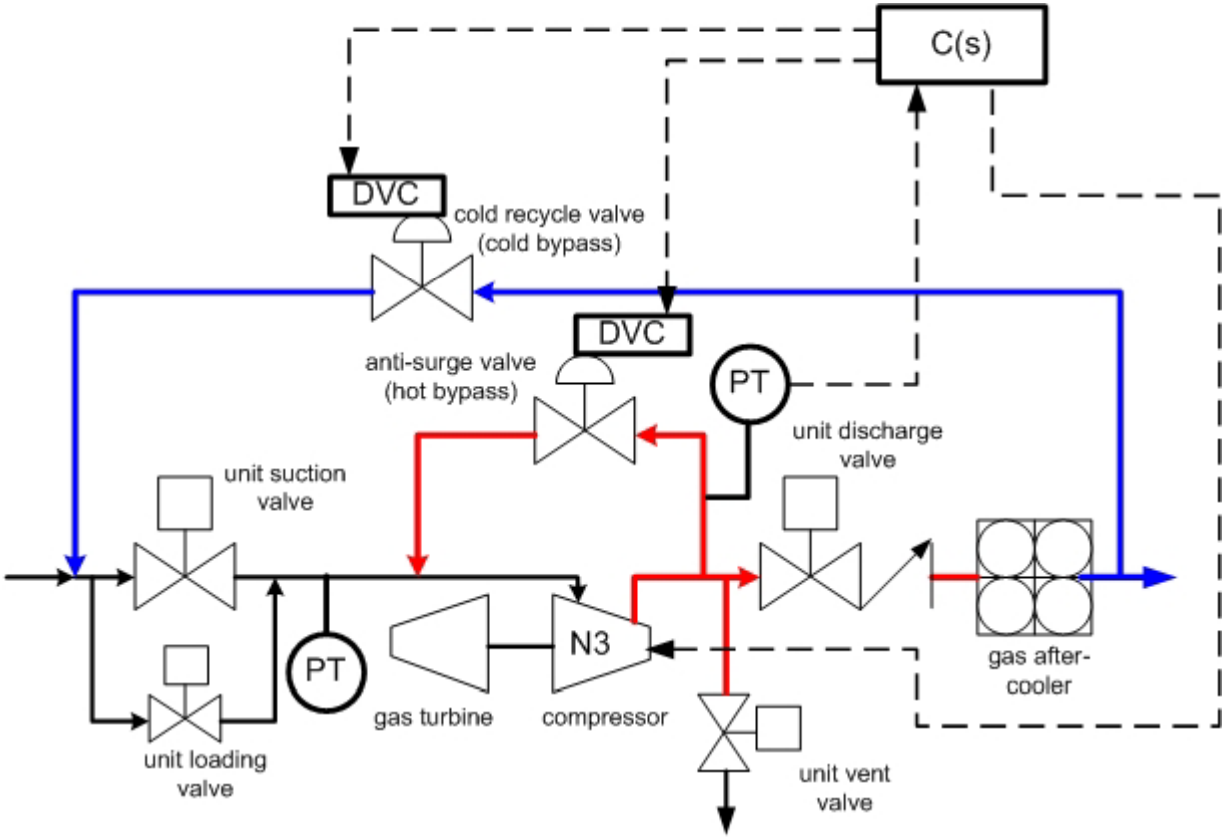
Facility map



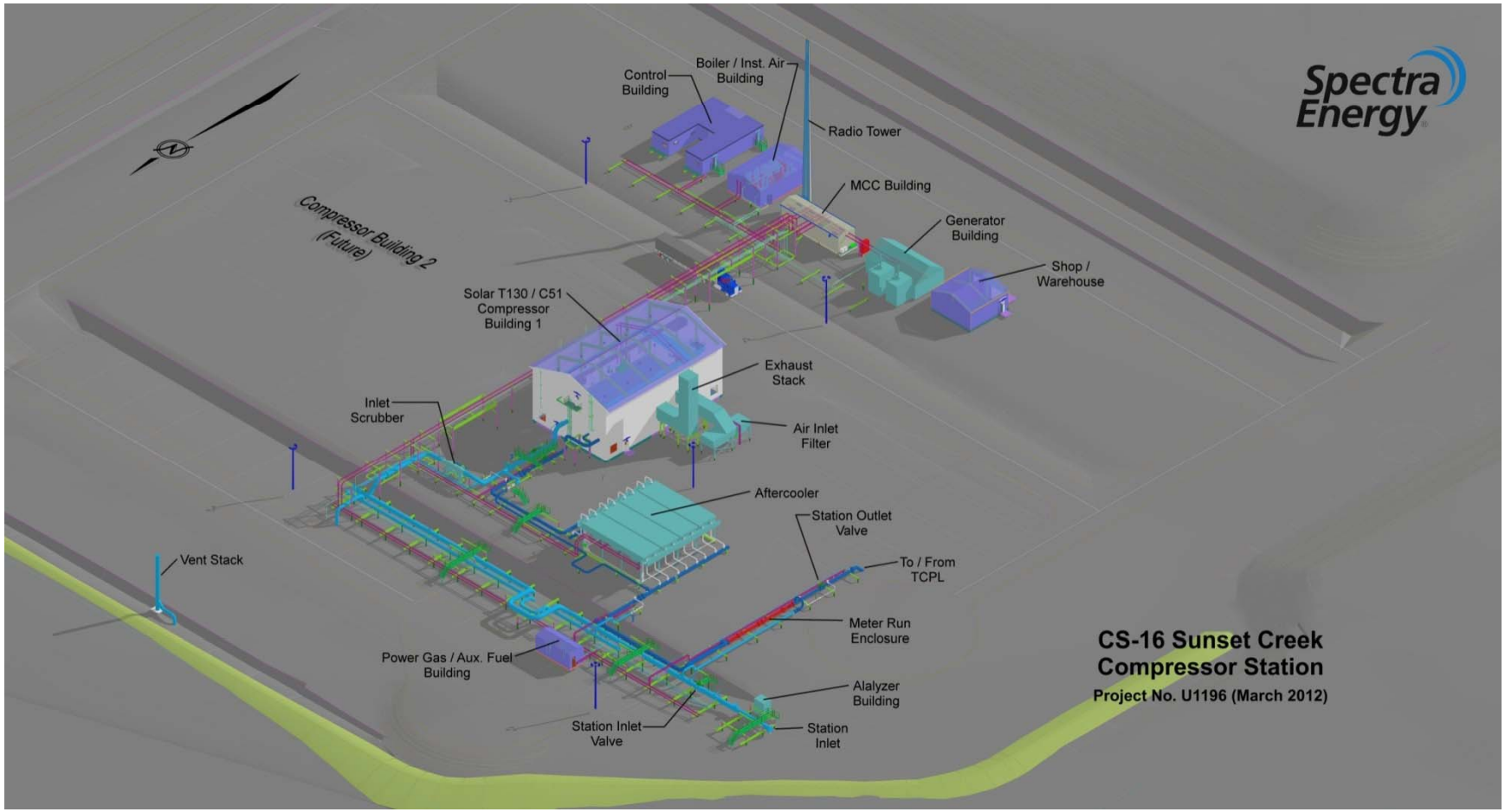
Dawn ‘J’ model


suction
Cold bypass loop
Compressor set
discharge
Hot bypass loop
Gas aftercoolers

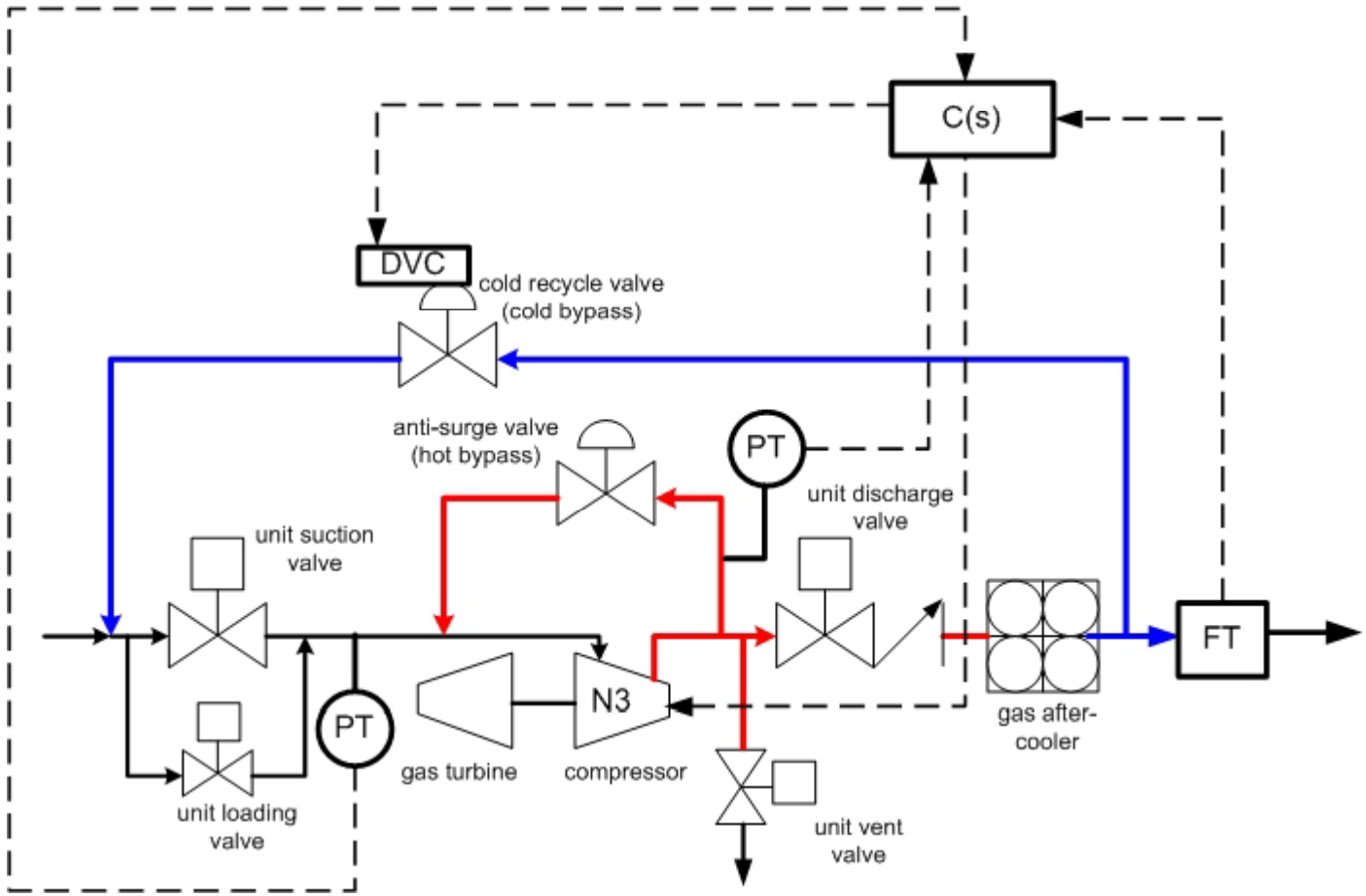
Dawn ‘J’: process control



Sunset Creek model



Sunset Creek: process control



Control System: protection

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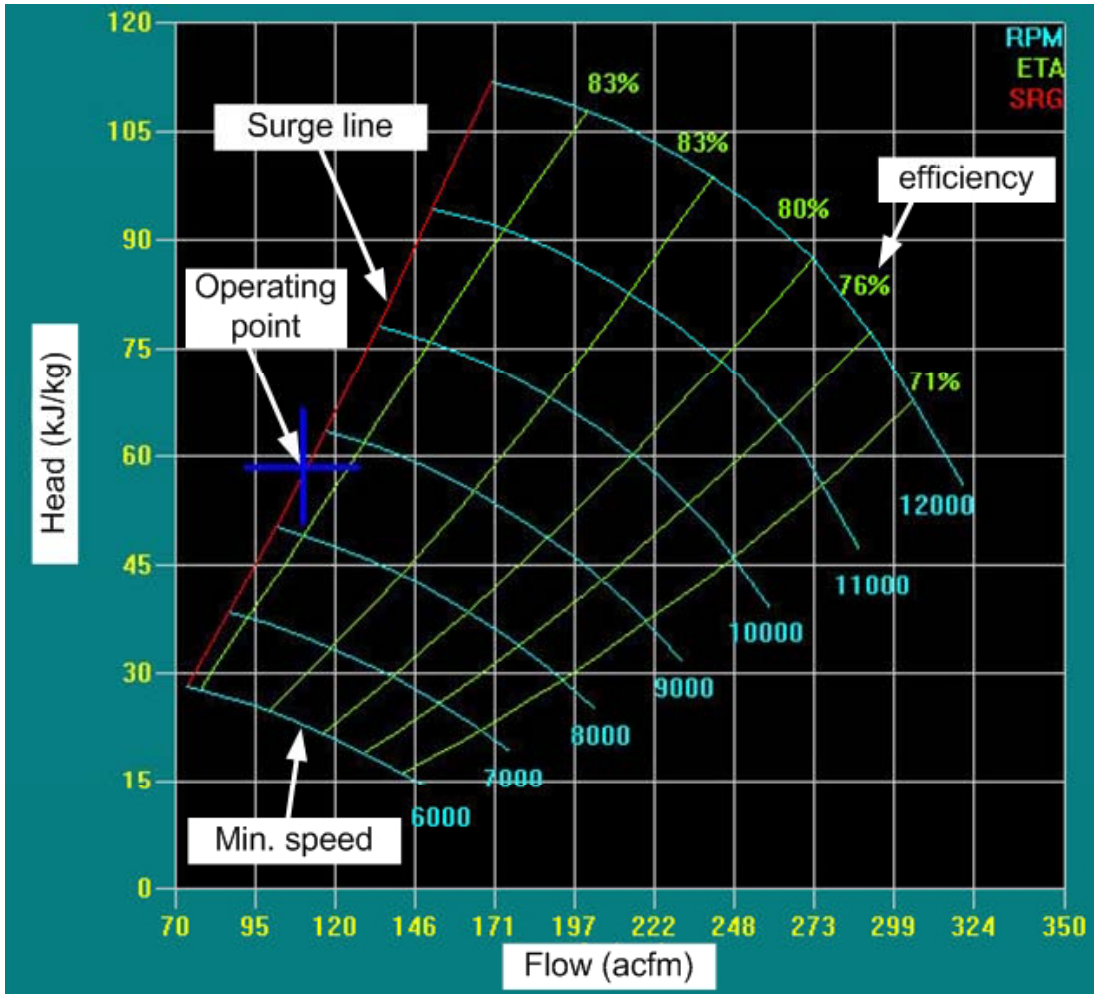


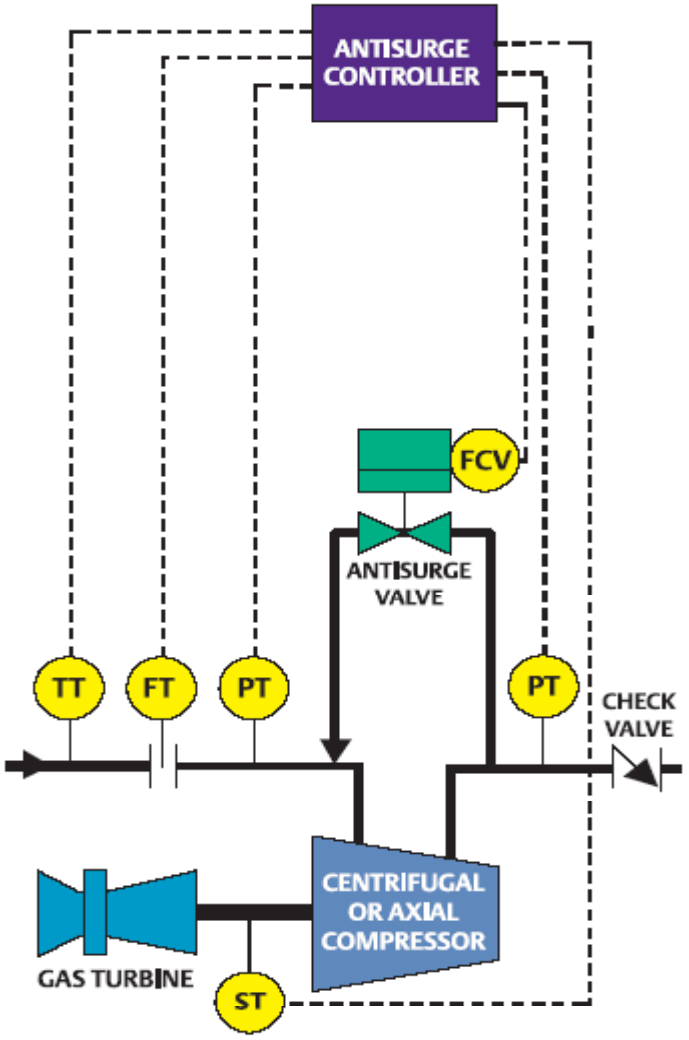
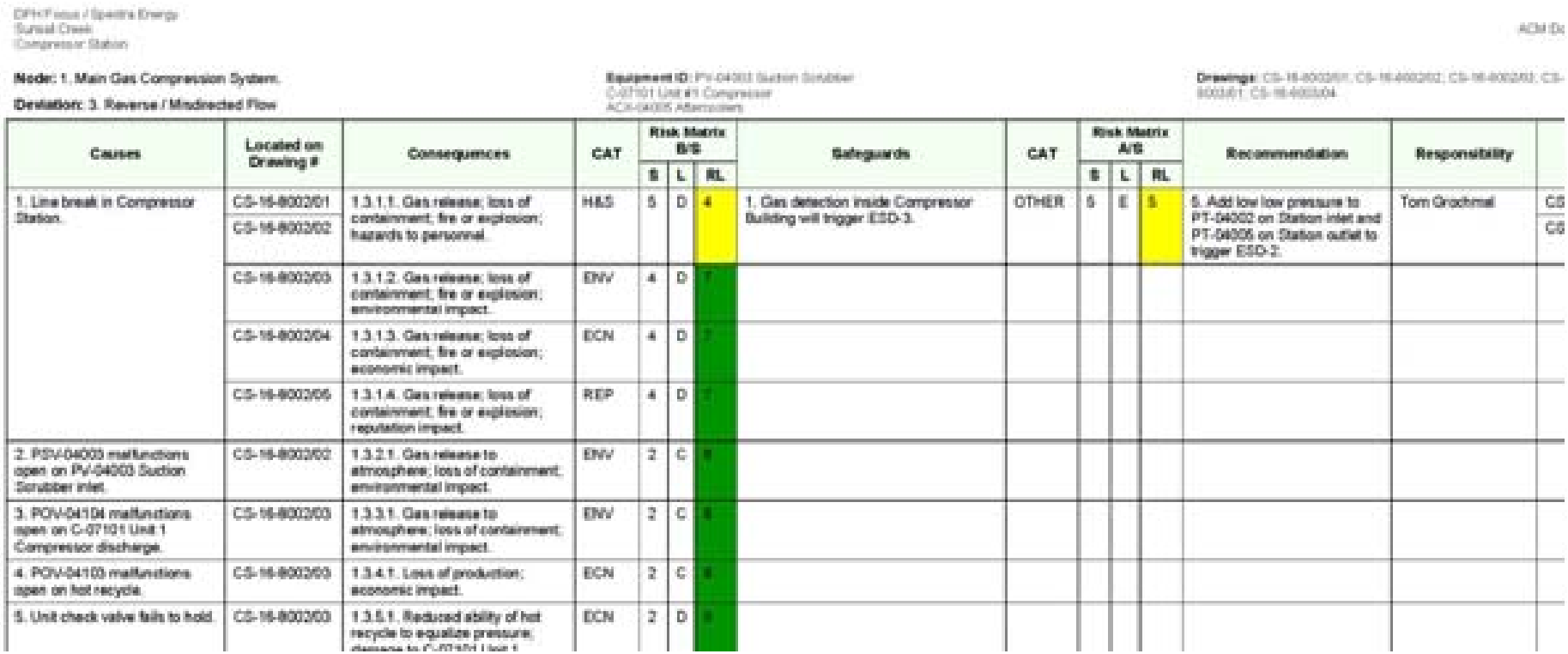


Figure Courtesy of Compressor Controls Corp.

Control system: enhanced process safety



DPH Focus / Spectra Energy
Sunset Creek
Compressor Station

ACM Do

Node: 1. Main Gas Compression System.

Deviation: 3. Reverse / Misdirected Flow

Equipment ID: PV-04003 Suction Scrubber
C-07101 Unit #1 Compressor
ACM-04005 Aftercooler

Drawings: CS-16-8002/01; CS-16-8002/02; CS-16-8002/03; CS-8003/01; CS-16-8003/04

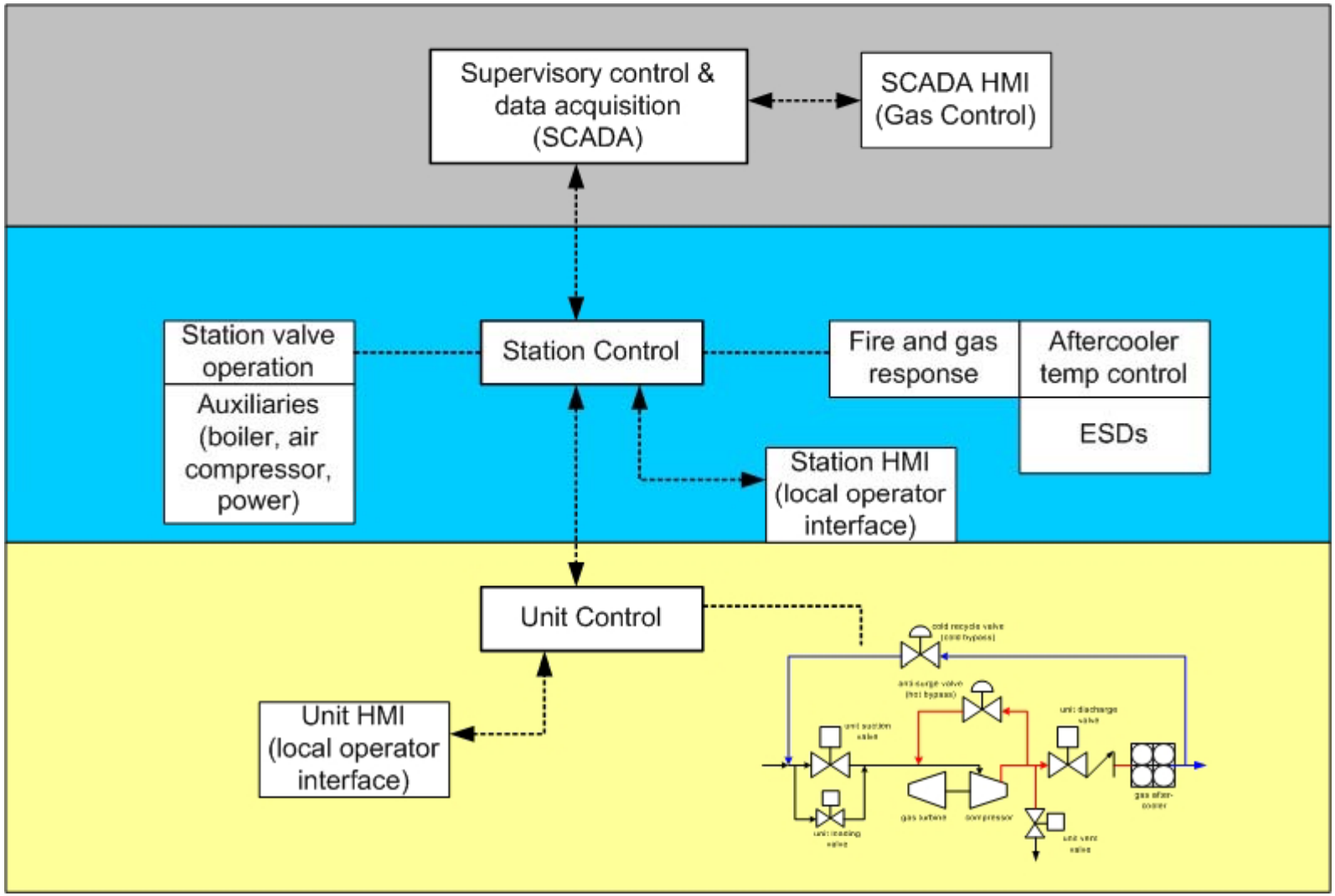
Causes	Located on Drawing #	Consequences	CAT	Risk Matrix B/S			Safeguards	CAT	Risk Matrix A/S			Recommendation	Responsibility	
				S	L	RL			S	L	RL			
1. Line break in Compressor Station.	CS-16-8002/01 CS-16-8002/02	1.3.1.1. Gas release; loss of containment; fire or explosion; hazards to personnel.	H&S	5	D	4	1. Gas detection inside Compressor Building will trigger ESD-3.	OTHER	5	E	5	5. Add low low pressure to PT-04002 on Station inlet and PT-04005 on Station outlet to trigger ESD-2.	Tom Grochmal	CS CS
	CS-16-8002/03	1.3.1.2. Gas release; loss of containment; fire or explosion; environmental impact.	ENV	4	D	7								
	CS-16-8002/04	1.3.1.3. Gas release; loss of containment; fire or explosion; economic impact.	ECN	4	D	7								
	CS-16-8002/05	1.3.1.4. Gas release; loss of containment; fire or explosion; reputation impact.	REP	4	D	7								
2. PSV-04003 malfunctions open on PV-04003 Suction Scrubber inlet.	CS-16-8002/02	1.3.2.1. Gas release to atmosphere; loss of containment; environmental impact.	ENV	2	C	6								
3. POV-04104 malfunctions open on C-07101 Unit 1 Compressor discharge.	CS-16-8002/03	1.3.3.1. Gas release to atmosphere; loss of containment; environmental impact.	ENV	2	C	6								
4. POV-04103 malfunctions open on hot recycle.	CS-16-8002/03	1.3.4.1. Loss of production; economic impact.	ECN	2	C	6								
5. Unit check valve fails to hold.	CS-16-8002/03	1.3.5.1. Reduced ability of hot recycle to equalize pressure; damage to C-07101 Unit 1	ECN	2	D	6								

- HAZOP generates additional automation to enhance process safety.

Control system: enhanced monitoring

- Drivers: remote & unmanned operation
- Anything controlled by the station control system is accessible to the SCADA system or remote access software; e.g. building temperature control, intrusion, fire and gas, status of boilers, air compressors, generators
- Typical coupled with enhanced instrumentation practices
- Minimize stand alone/third-party control systems

Control system: architecture



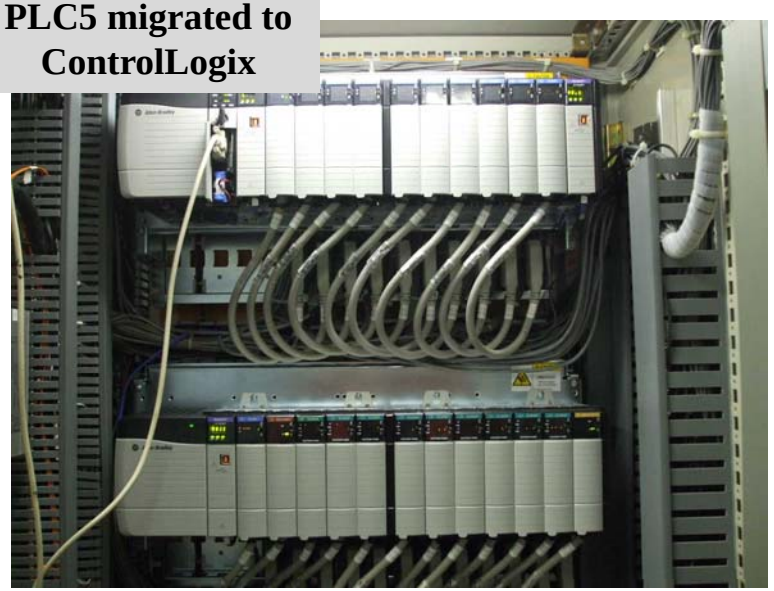
Control system: cyber security

- Growing recognition of difference between IT and industrial control systems
- CSA Z246.1: need for a security management plan (scope: SCADA, DCS, PLCs)
- Some of the requirements
  - firewall between industrial control system and corporate network
  - Prohibited use of wireless technology
  - Web-server security
  - Authorized access to HMIs and main control rooms

Trends & Conclusions

- Hardware independence
- PLCs maintaining their relevance
- More reliable/robust architecture

PLC5 migrated to ControlLogix



- Control systems are integral to safe, reliable and efficient operation of turbomachinery and surrounding infrastructure
- Control systems provide a certain amount of convenience; however certain aspects are “engineered”