Coker Valves Interlock Improvement Project at Suncor Energy Inc.

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Background

•Upgrader II (U2) coke drums utilizes motor operated valves to operate coke drum valves during the various coking cycle operation. These coker valves are interlocked to coke drum pressure and temperature including valve position of appropriate coker valves.

•Relevant incident on Oct. 2007, one of coke drum had a fire from opening the ejector valve while the drum is being charged. Est. production loss $ 30 M.

•In another incident, two coker operators were removing top head of coke drum when steam released occurred. One operator received second degree burns.

•On Jan. 2011 from another Oil Sands operator, the wrong coker valve was opened causing massive fire to their coker. Est. damage and losses $ 500 M including 3 injured personnel.

Objective

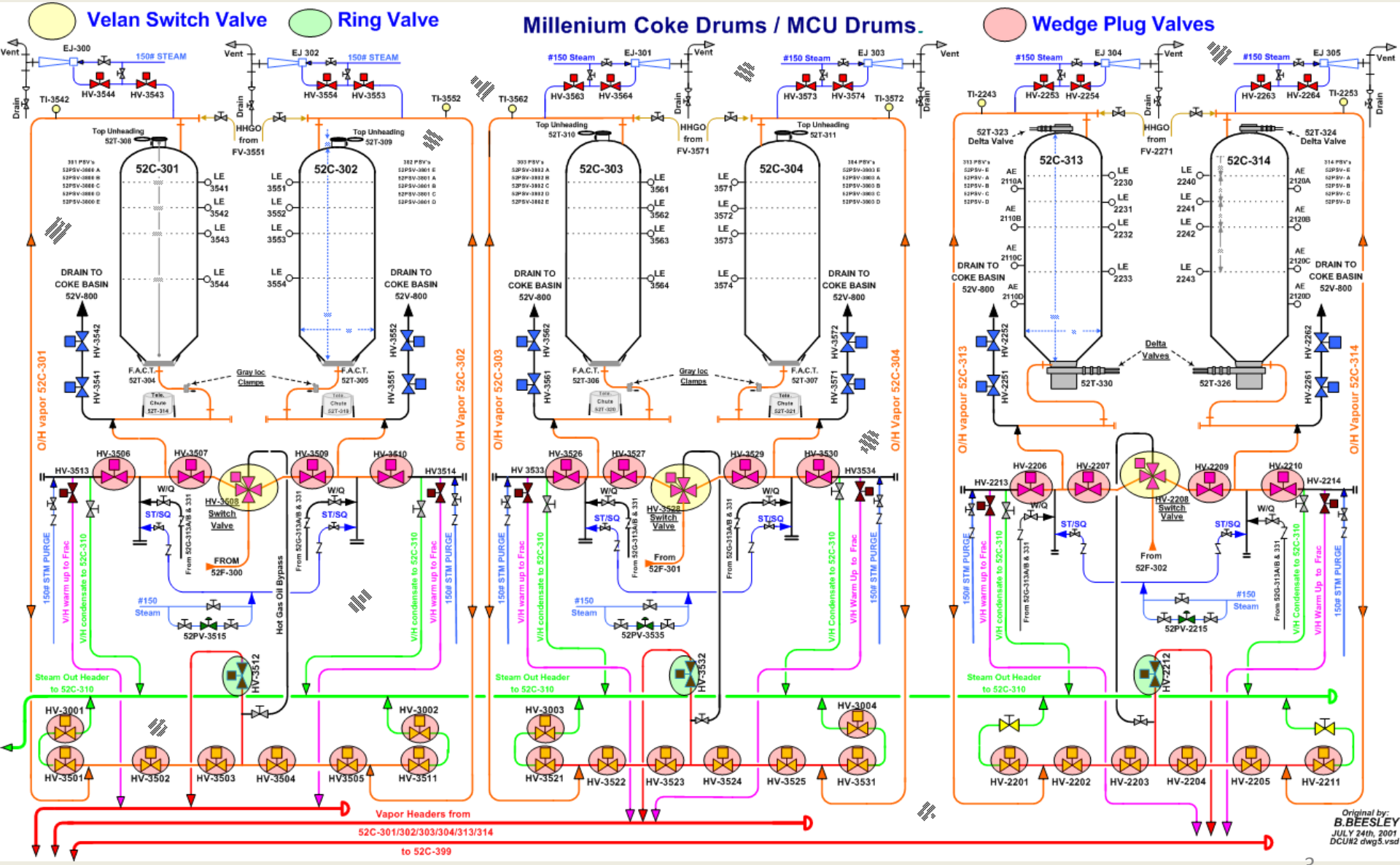
•Eliminate potential loss of containment from valve misalignment or operating incorrect valve during coker valves operation.

•Implementation of coker valve interlocks and permissives that will prevent from opening a hot drum during the various coking cycle.

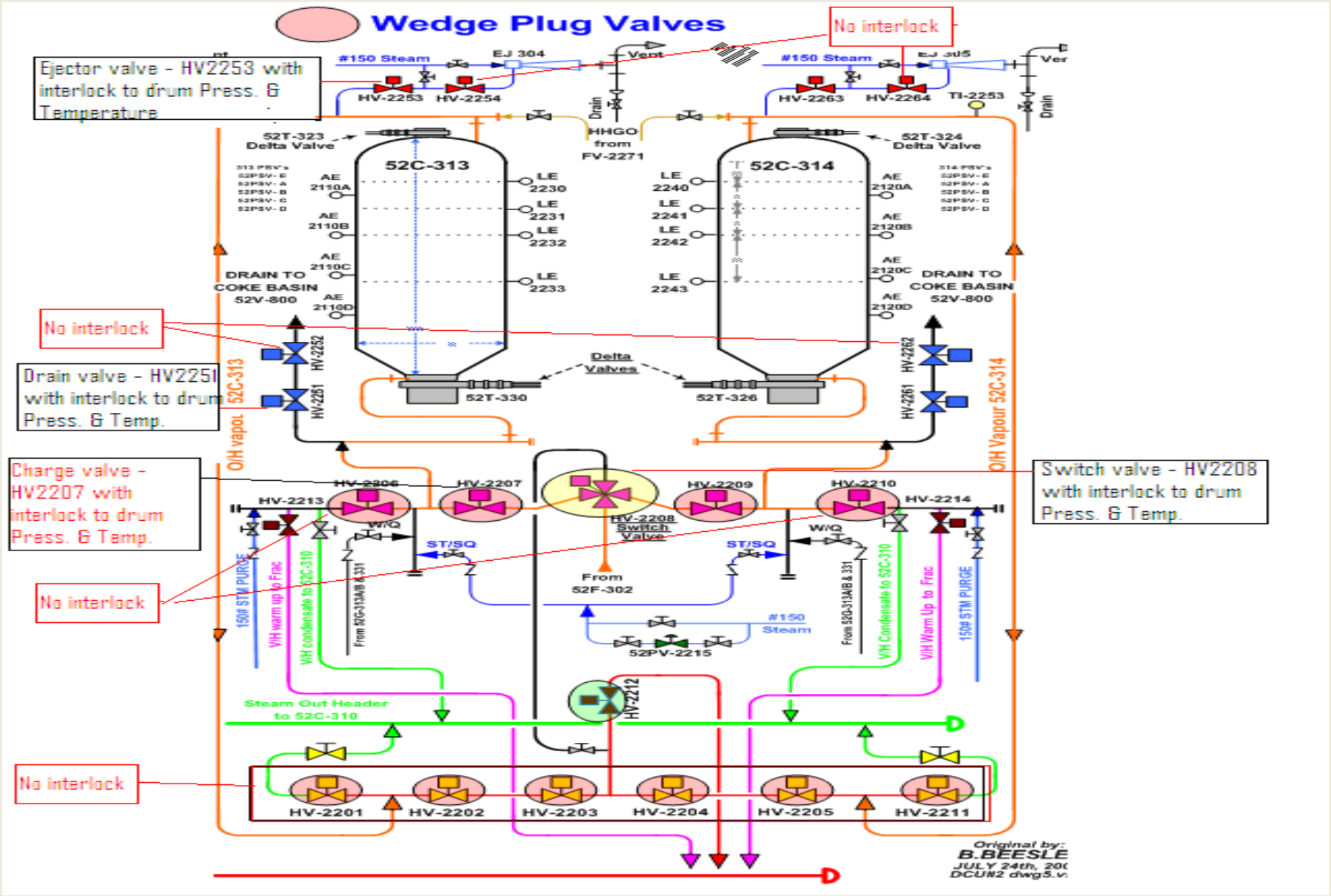
•Implementation of DCU PHA / LOPA recommendations which require additional permissive during coker valve operation.

•Monitoring and trending of coker valve position and torque feedback for valve deterioration.

Upgrading coke drums with coker valves



Coker drum set with original coker valves interlock setup



Existing setup

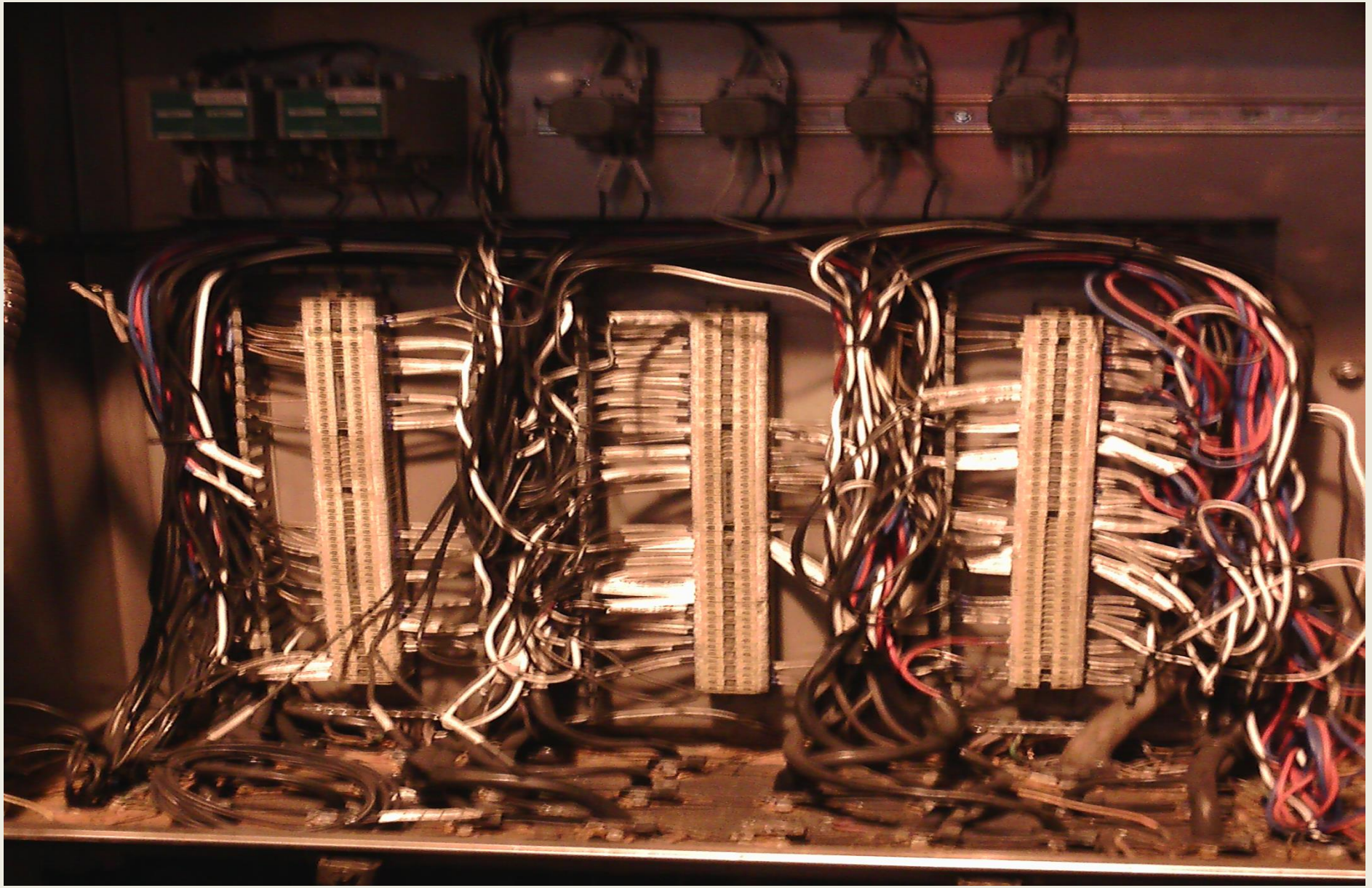
- Inadequate interlocks on coker switch valve, charge, ejector and drain valves due to limited capability of current interlock system using electro-mechanical relays in the switch valve panel.

- Limited interlock as only the first or inside valve on the ejector and drain valves are available. There is no interlock on the outside or second valve.

- There are no valve interlocks to blowdown, warm up, vapour and steam out valves potentially causing misalignment or incorrect valve operation.

- Temporary jumper wires are installed in the relay switch panel when coker valve does not reach limit switch. This will require electrician to install and monitor jumper wire status after each coking cycle.

Original electro-mechanical relay panel



Solution

- Install PLC for coker valve interlock system for all 6 coker drums. Control logic can be programmed for more robust interlock setup.

- Install local HMI in the coker switch deck for monitoring valve interlock status and valve torque & position. Capability for trending of valve torque for monitoring valve deterioration or degradation.

- Provide additional valve interlock to other coker valves as per PHA / LOPA recommendations.

- Provide DCS bypass for each valve interlock which is traceable, monitored and audited.

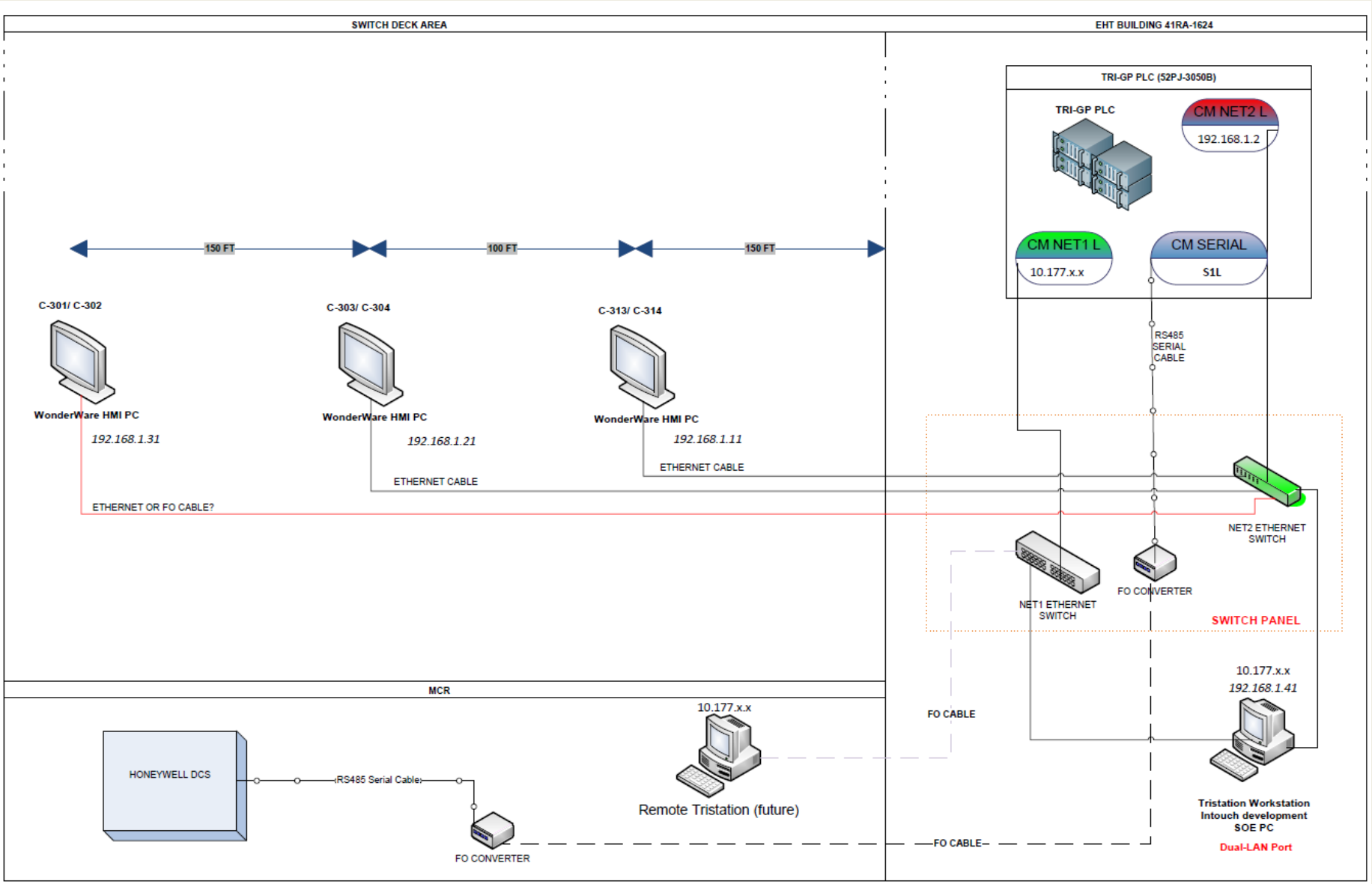
Coker valve interlock PLC panel

Figure 1. G80 Trident System Enclosure, Front Left View

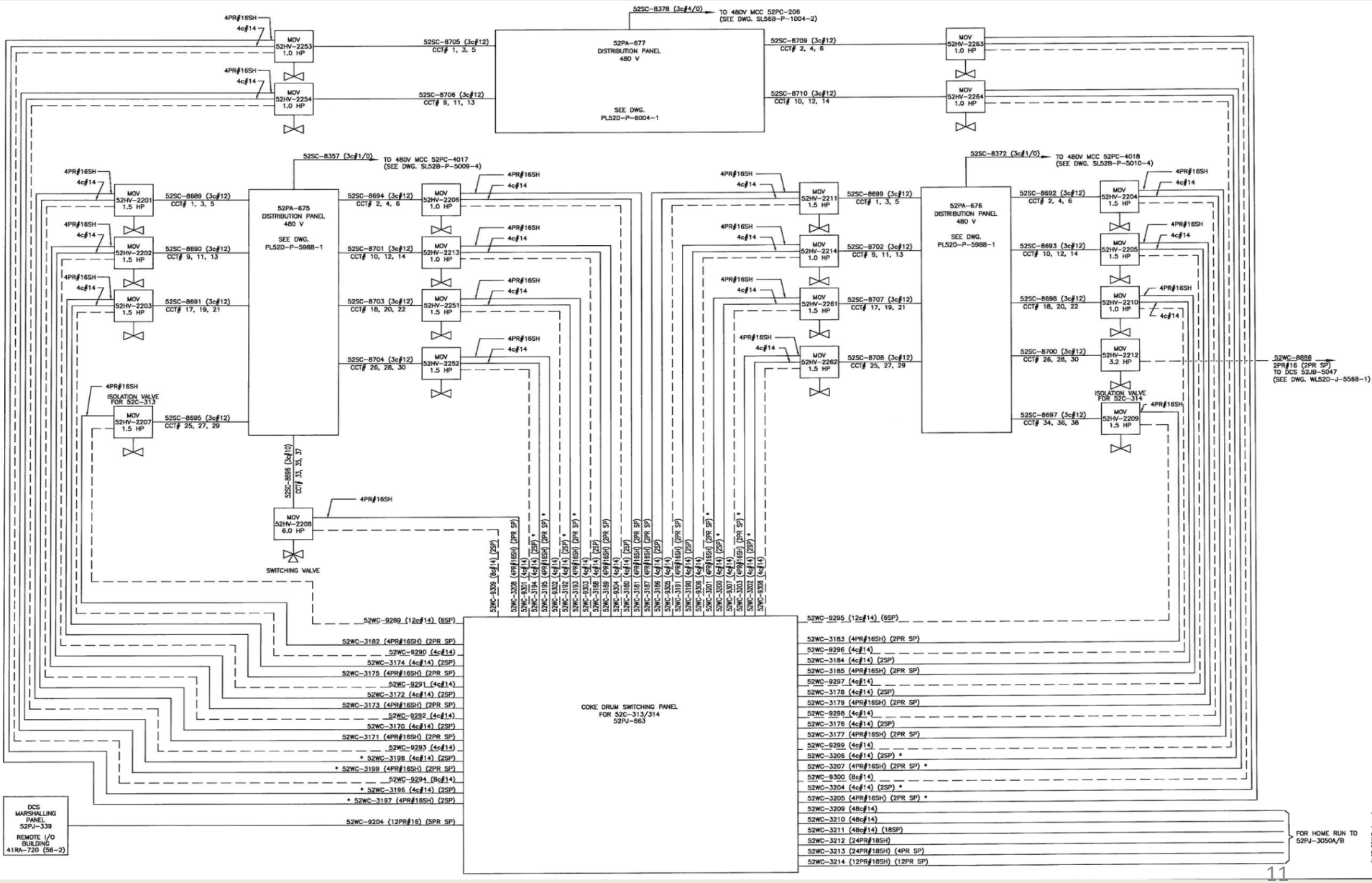
Coker valve interlock table

VALVE DESCRIPTION 52C-313	PERMISSIVES	PERMISSIVE TO CLOSE VALVE (PHASE 2)	PERMISSIVE TO OPEN / OPERATE VALVE	CHARGE VALVE 52HV-2207	CHARGE OR VAPOUR TEMPERATURE > 350 F TI-2202 / 2243 & CHARGE OR VAPOUR > 20 PSIG PY2252	CHARGE OR VAPOUR TEMPERATURE < 300 F TI-2202 / 2243 & < 10 PSIG PY2252	EJECTOR VALVE 52HV-2253	EJECTOR VALVE 52HV-2254	DRAIN VALVE 52HV-2251	DRAIN VALVE 52HV-2252	WARM UP VALVE 52HV-2213	BLOWDOWN VALVE 52HV-2206	STEAM OUT VALVE 52HV-2201	VAPOUR HEAT VALVE 52HV-2202	VAPOUR HEAT VALVE 52HV-2203	TOP DELTA VALVE 52T-323	BOTTOM DELTA VALVE 52T-330	10 INCH MANUAL BLOWDOWN VALVE (PHASE 2)
52HV-2208 SWITCH VALVE (Ready to switch to C-313)			Y	O	Y		C	C	C	C	C	C	C	O	O	C	C	C
52HV-2207 CHARGE VALVE			Y		Y		C	C	C	C	C	C	C			C	C	C
52HV-2206 BLOWDOWN VLV			Y	C			C	C	C	C			C	O	O	C	C	
52HV-2213 WARM UP VLV			Y	C	>400F Y		C	C	C	C		O	C	O	O	C	C	C
52HV-2201 STEAM OUT VLV			Y	C			C	C	C	C	C	C				C	C	C
52HV-2202 VAPOUR HEAT VLV			Y		Y		C	C	C	C	C	C	C			C	C	C
52HV-2203 VAPOUR HEAT VLV			Y		Y		C	C	C	C	C	C	C			C	C	C
52HV-2253 EJECTOR VENT U/S VLV			Y	C		Y					C		C	C	C			C
52HV-2254 EJECTOR VENT D/S VLV			Y	C		Y					C		C	C	C			C
52HV-2251 DRAIN U/S VLV			Y	C		Y					C		C	C	C			C
52HV-2252 DRAIN D/S VLV			Y	C		Y					C		C	C	C			C
START UP (PHASE 2)			Y	C							C	C	C	C	C	C	C	C
SUPER HEAT (PHASE 2)			Y	O			C	C			C					C	C	C
LEGEND:			N / A															
	Y		YES - INTERLOCK / PERMISSIVE															
	C		VALVE CLOSE POSITION															
	O		VALVE OPEN POSITION															

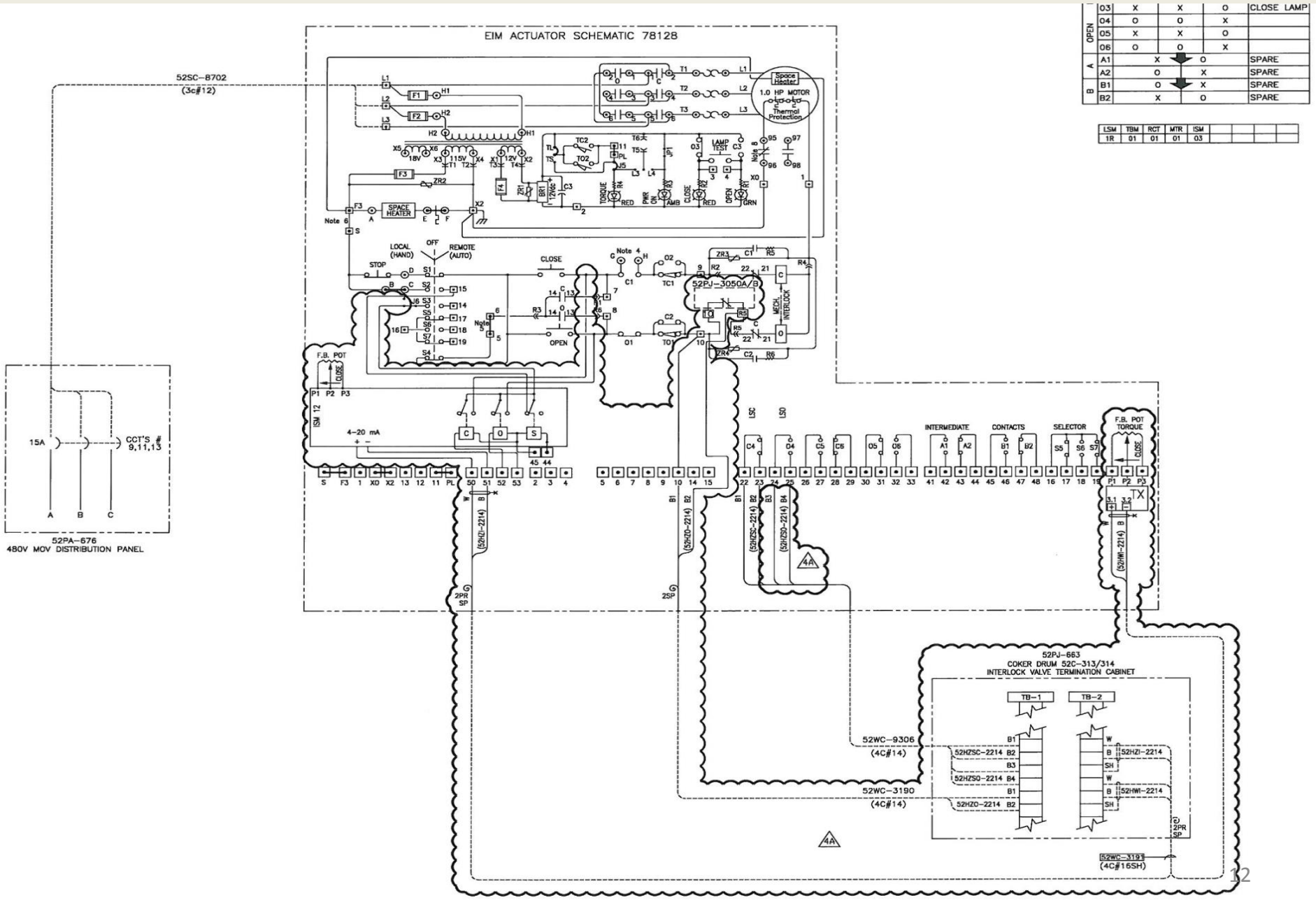
System Architecture for coker interlock project



Interconnection diagram for one set of coke drum



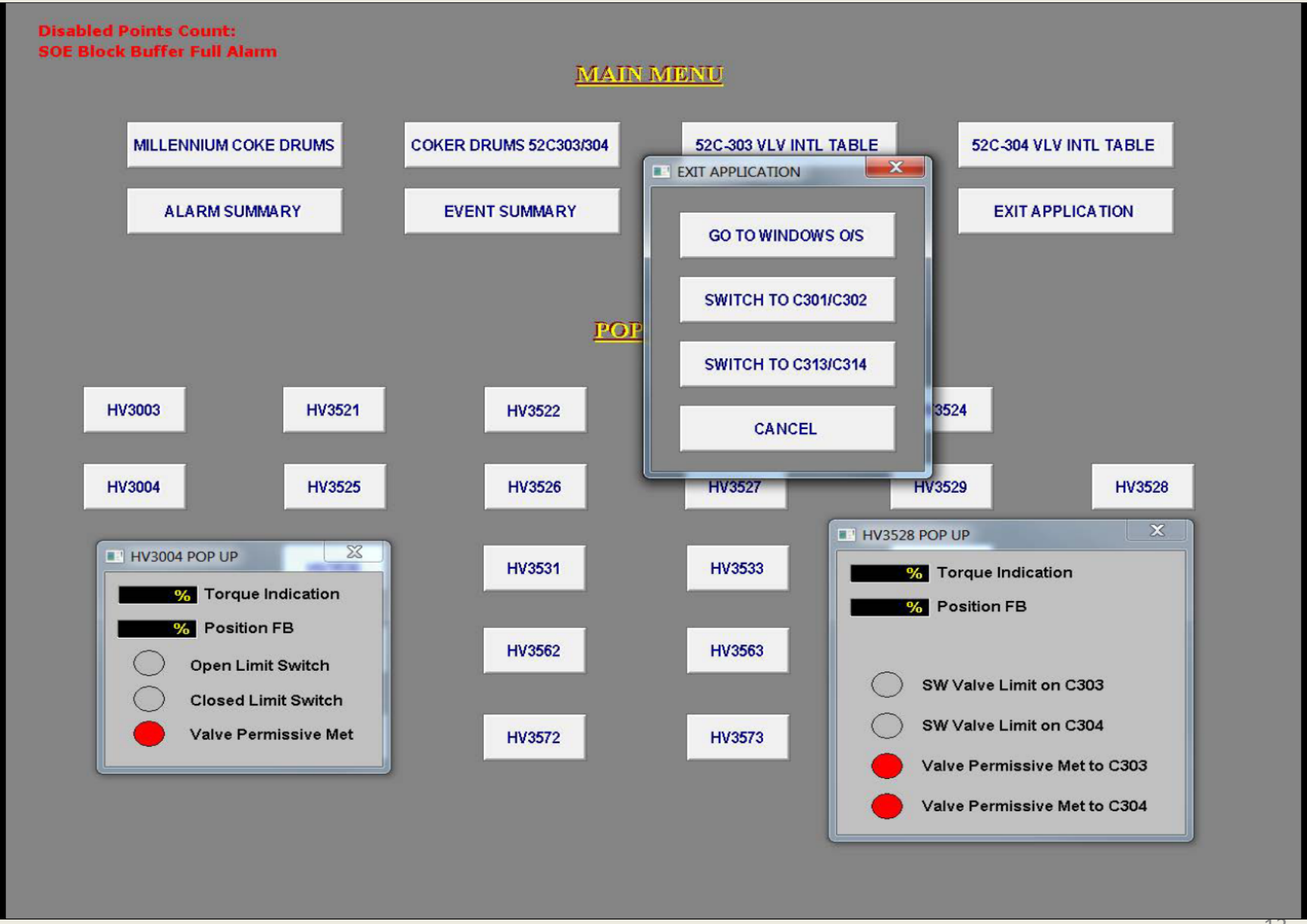
MOV Actuator schematic diagram modification for valve position & torque



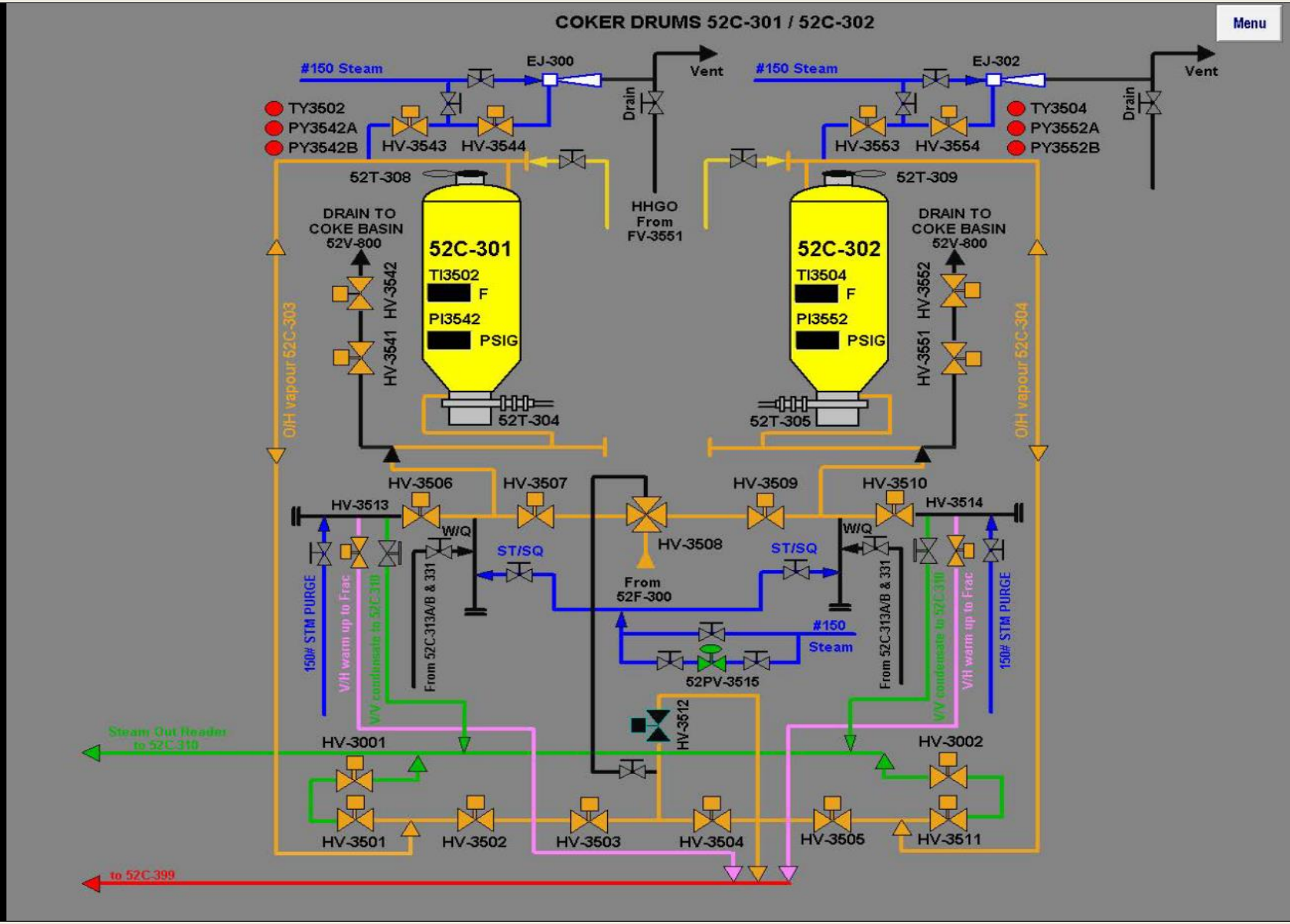
OPEN	03	X	X	O	CLOSE LAMP
	04	O	O	X	
	05	X	X	O	
	06	O	O	X	
A	A1	X	O		SPARE
	A2	O	X		SPARE
B	B1	O	X		SPARE
	B2	X	O		SPARE

LSM	TBM	RCT	MTR	ISM				
1R	01	01	01	03				

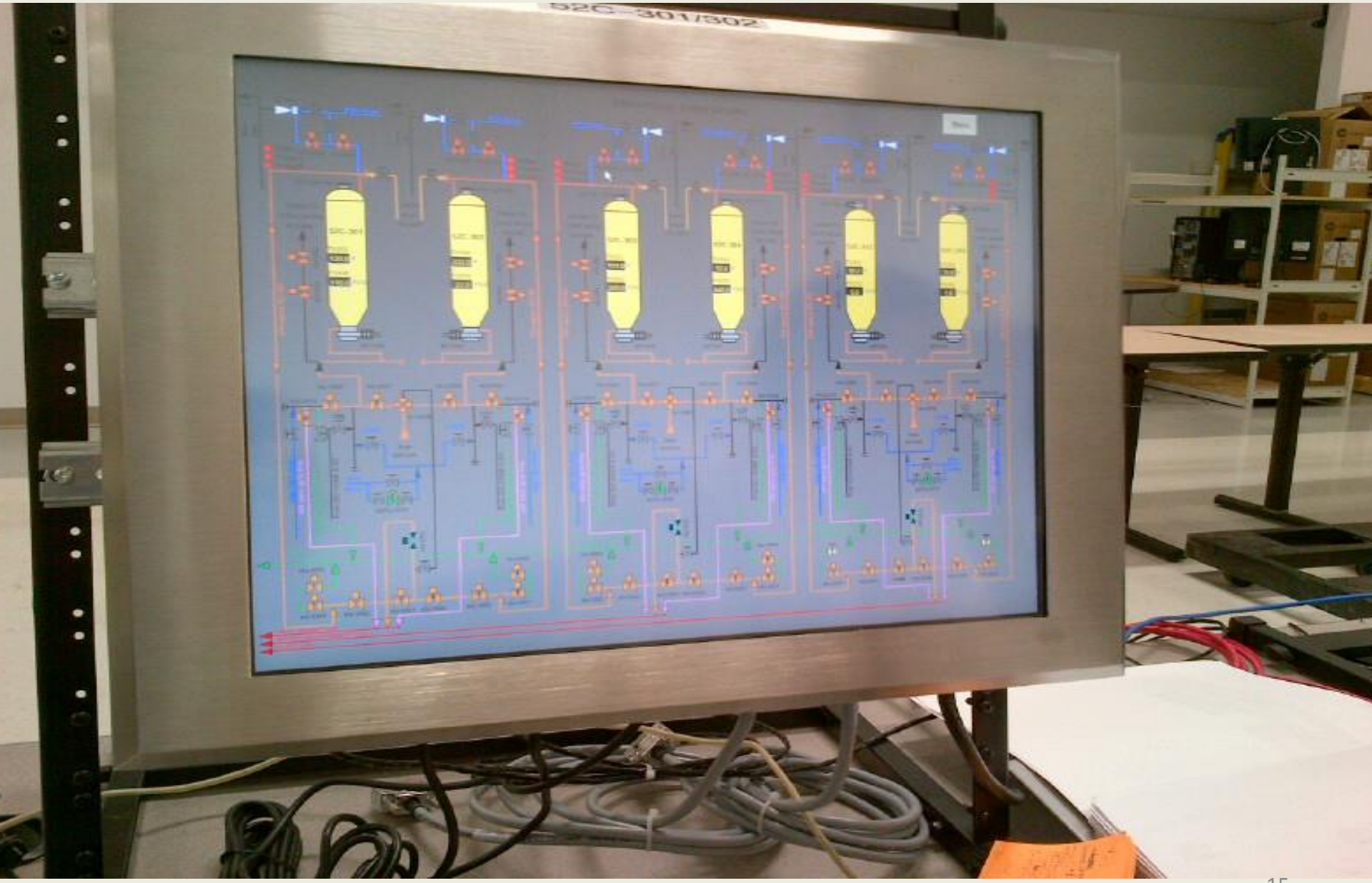
Pop up screen for valve position feedback and torque



HMI Display for one set of coke drum



Wonderware HMI Panel – Coker valve interlock



Benefits from PLC based interlock

- Display coker valves status i.e. valve position and torque
- Coker valves permissive status are readily available on DCS & HMI
- Increased coker operator productivity due to ease of troubleshooting
- Interlock bypasses are monitored and audited on a daily basis
- Modification of interlock or permissive can be easily implemented on PLC

Project execution

- Project implementation by Maintenance and Reliability engineering team due to urgency of requirement and cost efficiency.
- Project engineer and maintenance coordinator were assigned to ensure planning and execution by contractors are well coordinated.
- Length of Cables Pulled – 15000 Feet
- 1700 Engineering man-hours
- 7000 man-hours electrical & instrumentation contractors

Conclusion

- Selection of the Triconex Tri GP PLC was the right choice for this project for the following reason:
  1. High degree of reliability with the triple redundant processor from Triconex up to SIL-2 rated PLC.
  2. Ease of maintenance and programming as the Tristation software is common throughout the plantsite. Minimal training required to our maintenance and control systems personnel.
  3. Fully integrated remote communication to our Honeywell TDC 3000 DCS and Tri-GP's serial communication module.
  4. Medium size no. of I/O's which is suitable for this type of project.
  5. Compact footprint of PLC panel due to space constraints.
- Right balance between system reliability and cost.

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