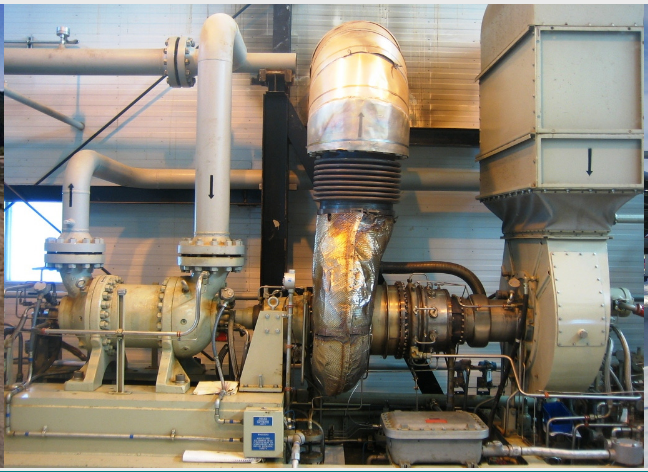


Waste Heat Recovery
Bigstone Plant
Brian Deschner

TALISMAN
ENERGY

Biography

- Employed with Talisman for 25 years
- Worked 14 years in Chauvin in Oilfield as Engineering Technologist, operated wells and batteries, optimized wells, managed downhole work and supervised service rigs
- The last 11 years have been focused in Edson area gas properties as an Operations Technologist
- Currently working in a role as Rotating Equipment Technologist
- Certified Engineering Technologist

TALISMAN ENERGY

Agenda

- Background – Bigstone Plant
- WHRU Project Background and Purpose
- Waste Heat Recovery Unit Design
- Controls– Instrumentation and Logic
- Challenges
- Installation
- Final Pictures
- Summary --Benefits / Impacts
- Moving Forward– Future Considerations
- Questions

TALISMAN ENERGY

Background - Bigstone Plant

- Plant was built in 1995 by Petromet Resources Ltd.
- Sweet gas plant at 14-28-59-22 W5M
- Licensed throughput of 80 mmcf/d sales and 85 mmcf/d raw
- Compression – 4 Reciprocating Inlet and 2 Solar Turbine Sales Compressors
- Starting looking at WHRU project in 2006, opportunity existed because of the need for additional heat in the process, installed in 2009

TALISMAN ENERGY

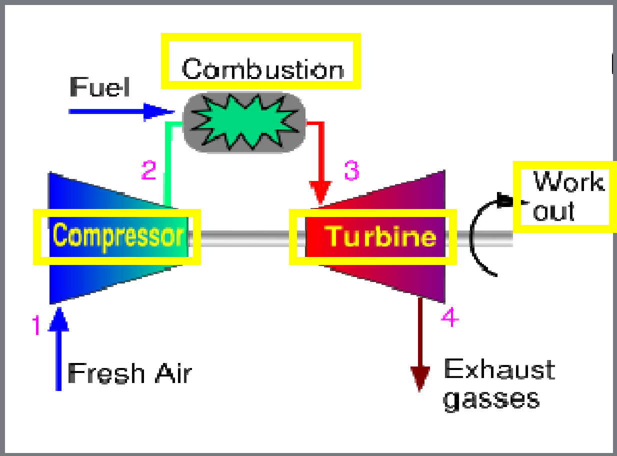
WHRU Project Background

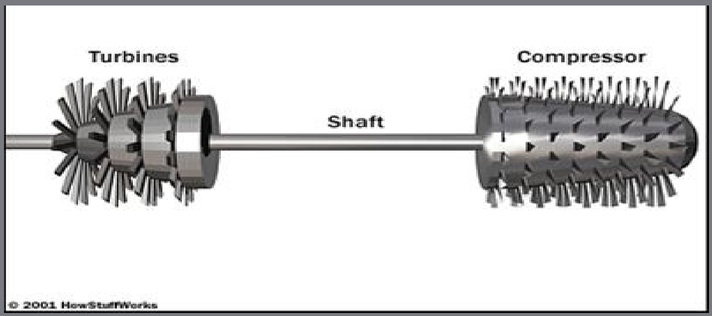
- Waste Heat Recovery Unit (WHRU):
  - Recovers waste heat from exhaust of sales compressors and use heat exchangers to heat process fluids
  - Replaces fired heaters in current heat systems
    Hot Oil (Process)
    Glycol (Heat tracing)
  - Fuel gas savings
  - Increases heat medium reliability
    Glycol system was taxed

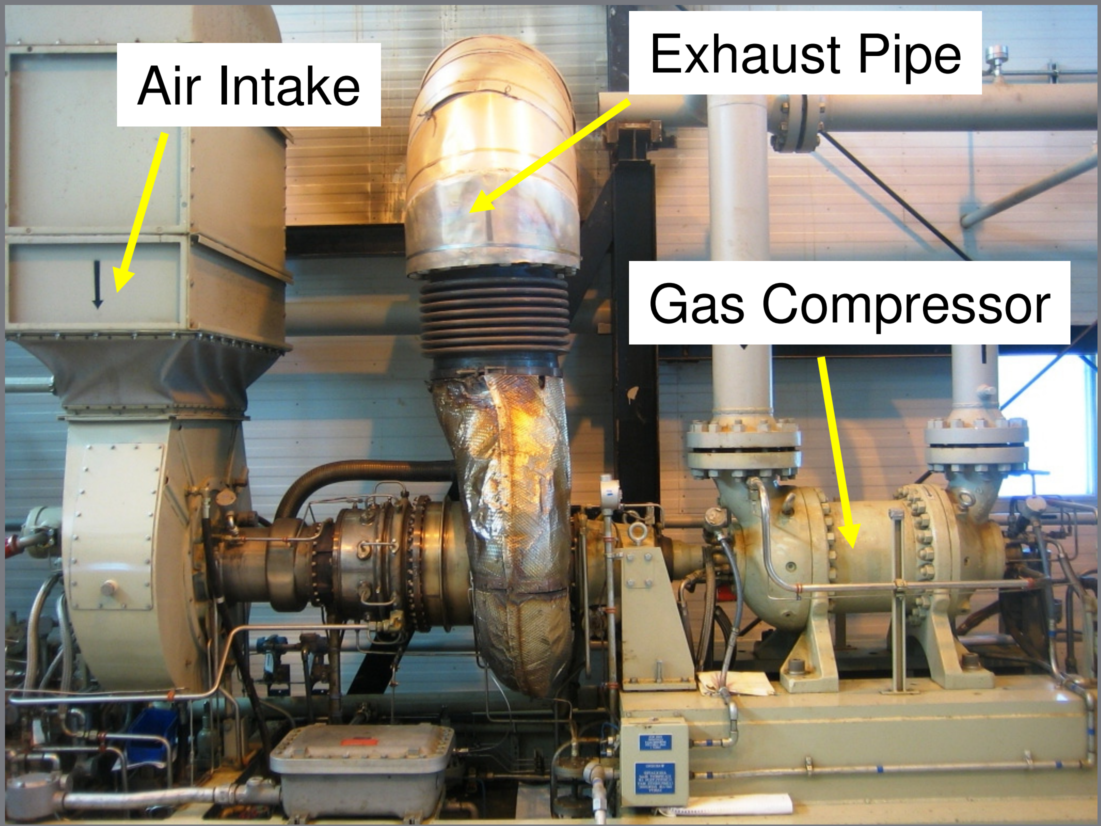
TALISMAN ENERGY

WHRU Project Background--Turbines

- Saturn T1600 Solar Turbine Engine
  - Centrifugal compressor attached







TALISMAN ENERGY

WHRU Project Background-- Turbines

- Outside view of Solar Turbine Building where WHRU was installed
- Replaced current exhaust stack with a dump stack and the WHRU (built into a second stack)
- Replaces fired heaters for hot oil and glycol (7.5 mm BTU/h)
- Excess heat is diverted up the dump stack

TALISMAN ENERGY

WHRU Project Background

- Installation Site:
  - WHRU replaced existing exhaust stack
  - This stack provided easy access to pipe-rack
  - Existing hot oil heater and glycol heater were kept in line

TALISMAN
ENERGY

WHRU Design- Sales Compressors

- Engine Performance:

Engine Inlet Temp	10.0 ℃
Driven Equipment Speed	22300 RPM
Net Output Power	987 kW
Heat Rate	15649 kJ/kWh
Inlet Air Flow	20994 kg/h
Engine Exhaust Flow	20215 kg/h
Exhaust Temperature	527 ℃

- Heat Output 11 mm BTU/h (One Turbine Exhaust)

TALISMAN ENERGY

WHRU Design-- Hot Oil Heater

- Design Conditions
  - Load 6.0 mm BTU/h
  - Inlet Temp 160 °C
  - Outlet Temp 180 °C

- Esso Thermoil-- Heat Transfer Oil 46
  - Max Temp 200 °C

- Fuel Gas Usage
  - Approx 175 mcf/d (6.0 mm BTU/hr)

- Heat Usage
  - Glycol reboiler to regenerate tri-ethylene glycol
  - De-ethanizer bottom and de-ethanizer reboiler to release light ends from condensate

TALISMAN
ENERGY

WHRU Design- Glycol Heater

- Design Conditions
  - Load 1.5 mm BTU/h
  - Inlet Temp 40 °C
  - Outlet Temp 80 °C

- 50/50 Ethylene Glycol – Water Mixture

- Fuel Gas Usage
  - Approx 125.0 mcf/d (1.5 mm BTU/h)

- Heat Usage
  - Building heat (roughneck heaters)
  - Heat Tracing (pipes and tanks)

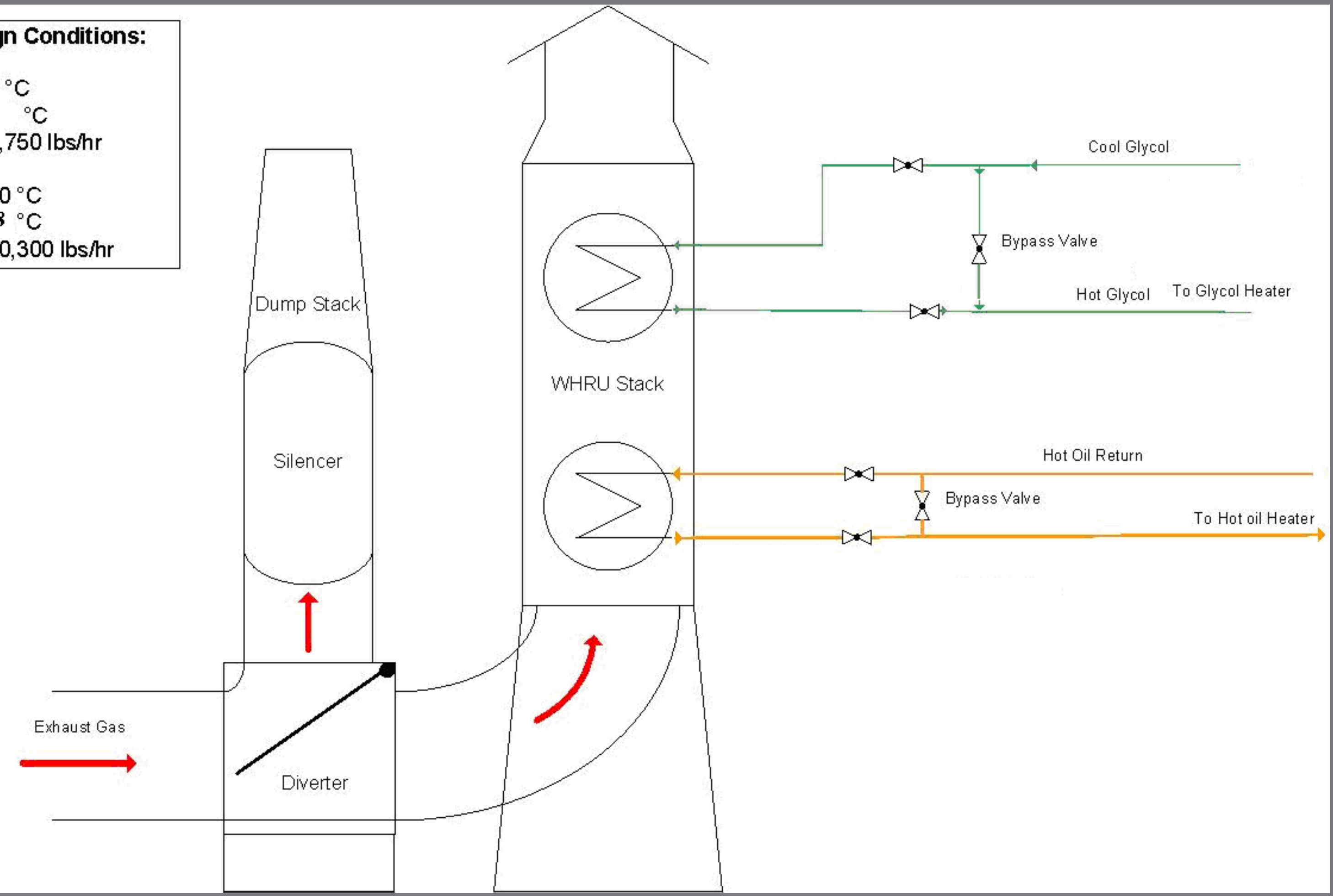
TALISMAN ENERGY

WHRU Design – Initial Concept

Proposed Design Conditions:

Glycol In = 40 °C
Glycol Out = 79 °C
Rate = 50,750 lbs/hr

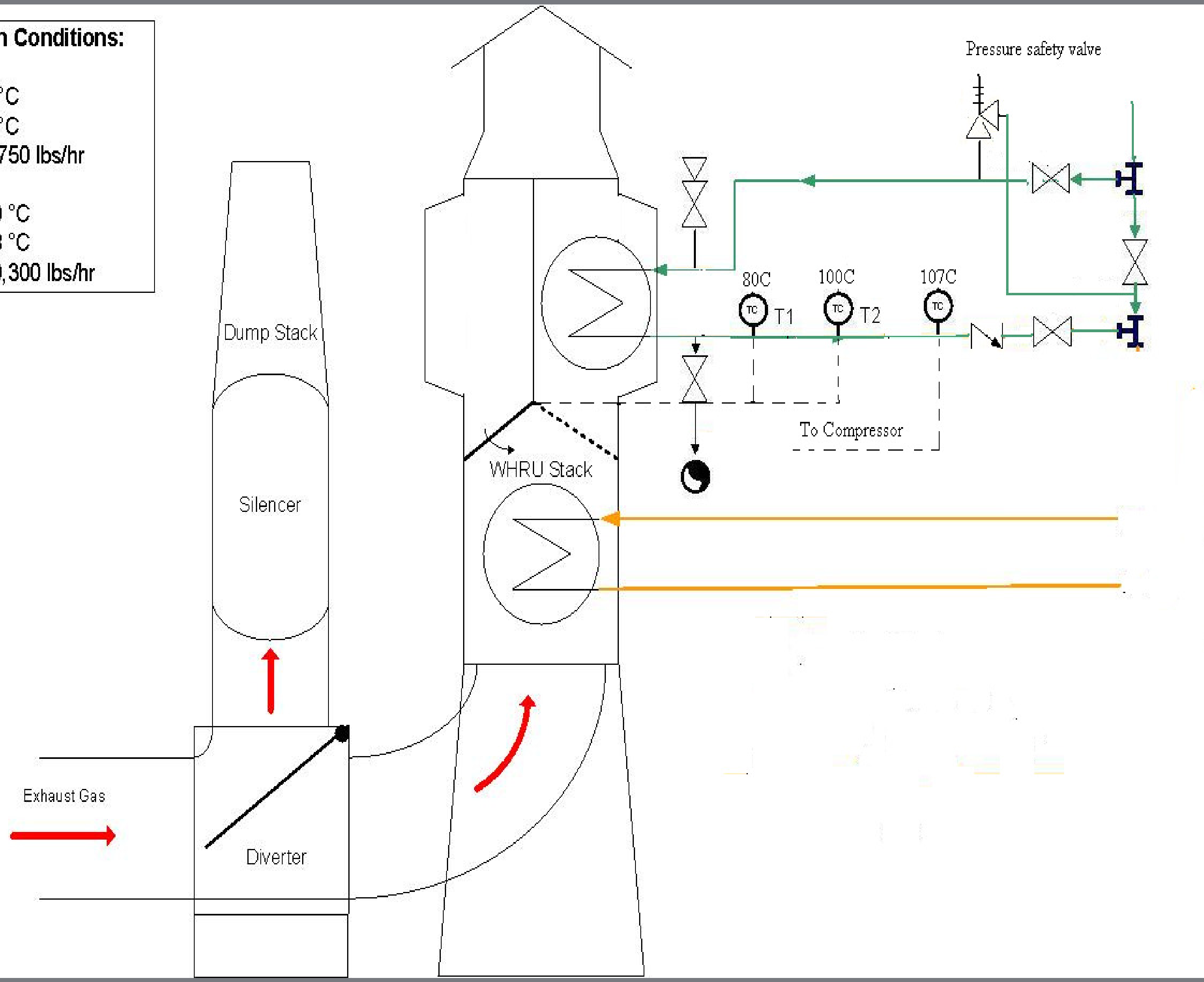
Hot Oil In = 160 °C
Hot Oil Out = 178 °C
Rate = 300,300 lbs/hr



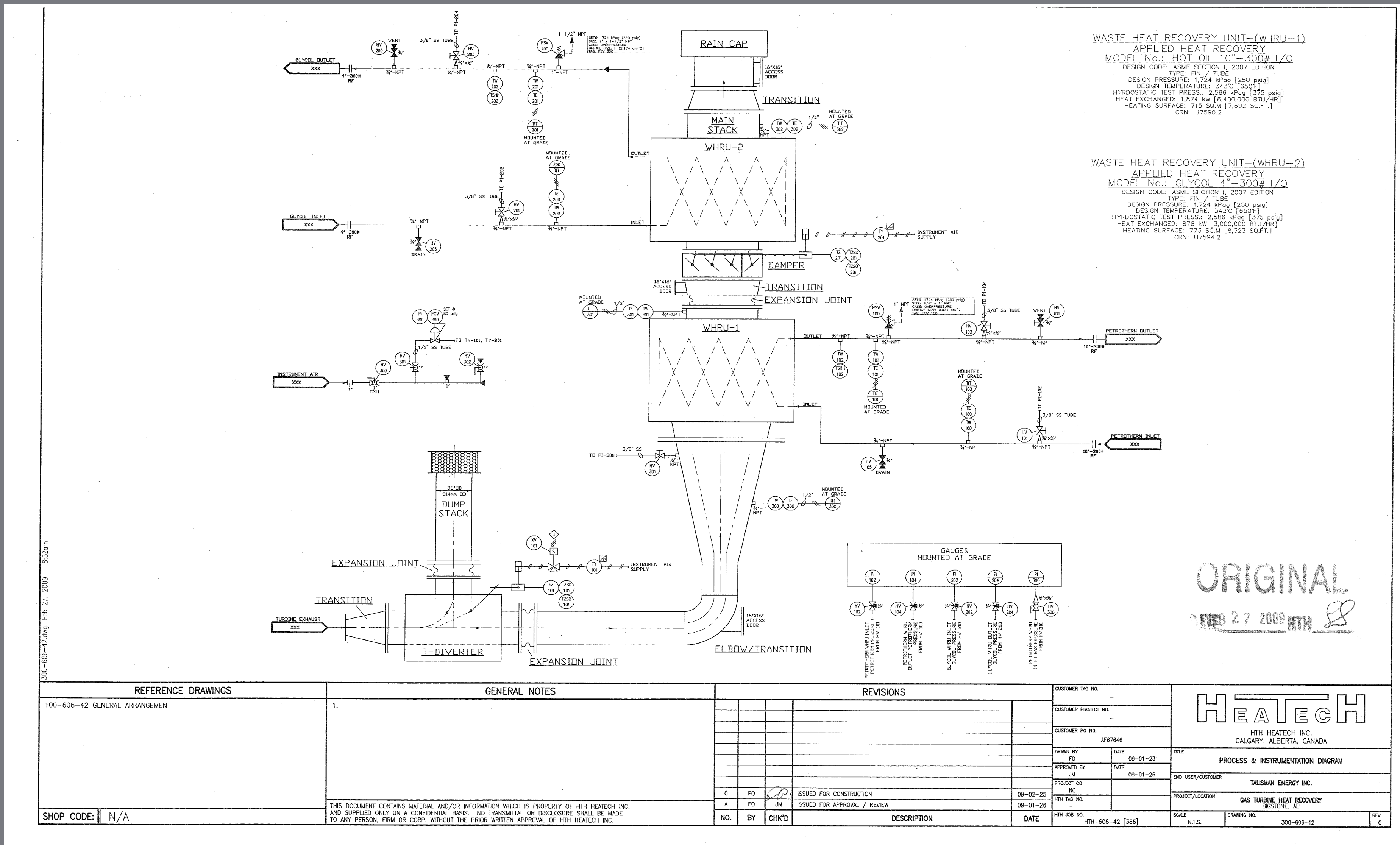
TALISMAN
ENERGY

WHRU Design – Final Design

Proposed Design Conditions:		
Glycol In	=	40 °C
Glycol Out	=	78 °C
Rate	=	50,750 lbs/hr
Hot Oil In	=	160 °C
Hot Oil Out	=	178 °C
Rate	=	300,300 lbs/hr



WHRU Design – Final Design



TALISMAN ENERGY

Controls

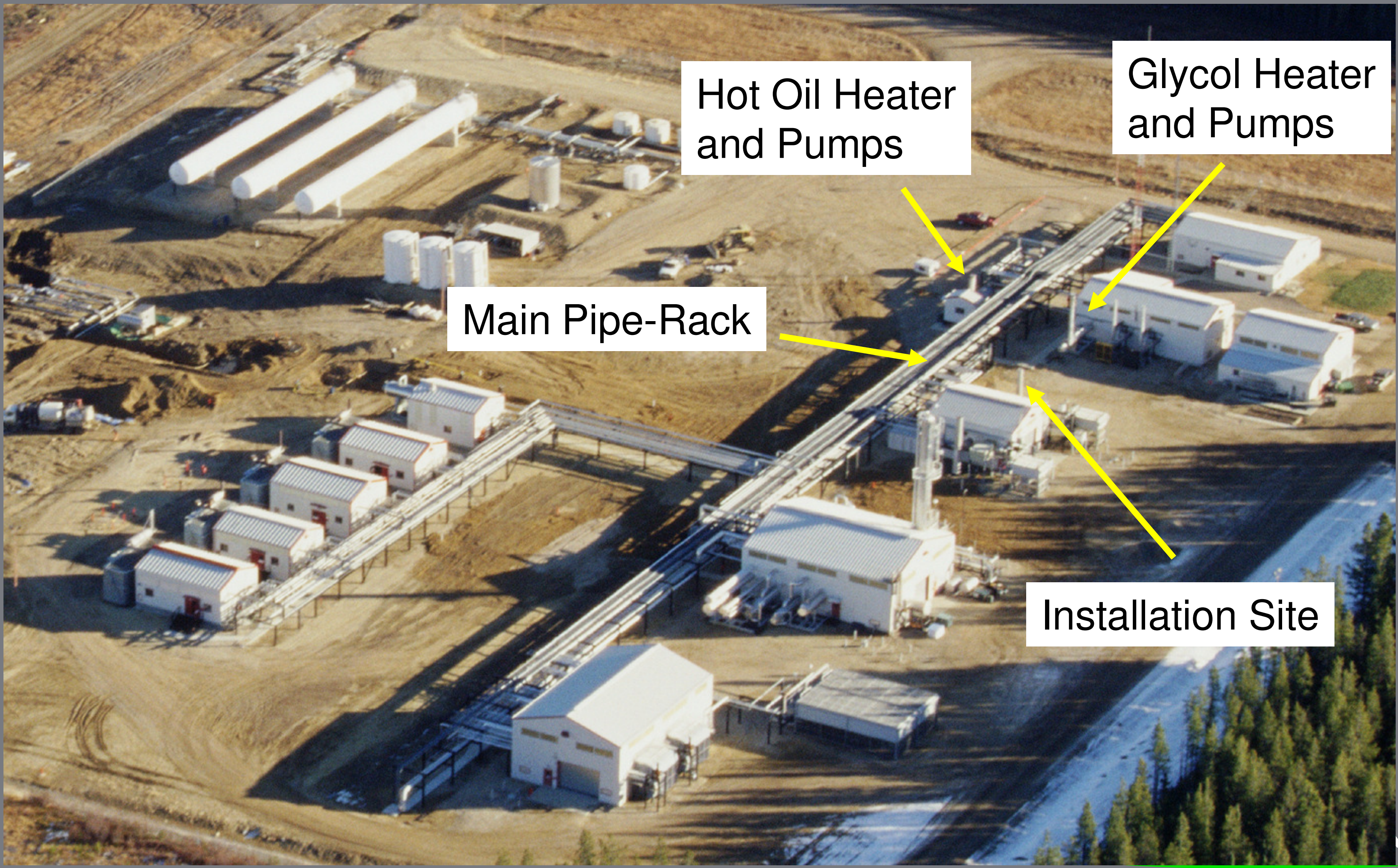
- Heat input into each thermo fluid needed to be controlled due to the extreme difference in operating temperatures
- Heat transferred to the hot oil and glycol controlled by exhaust flow through the WHRU Stack
- Exhaust flow is controlled by the main diverter for both fluids, glycol also secondarily controlled by additional damper
- Both fluids heated so that they reach optimum temperature as they return from the process
- Both fluids continue to run through existing fired line heater for additional heating if needed
- Both exchangers installed with high temperature protection and low flow protection, incorporated into the plant shutdown key
- Fire detection shutdown in stack (would be the result of ruptured tube)

TALISMAN ENERGY

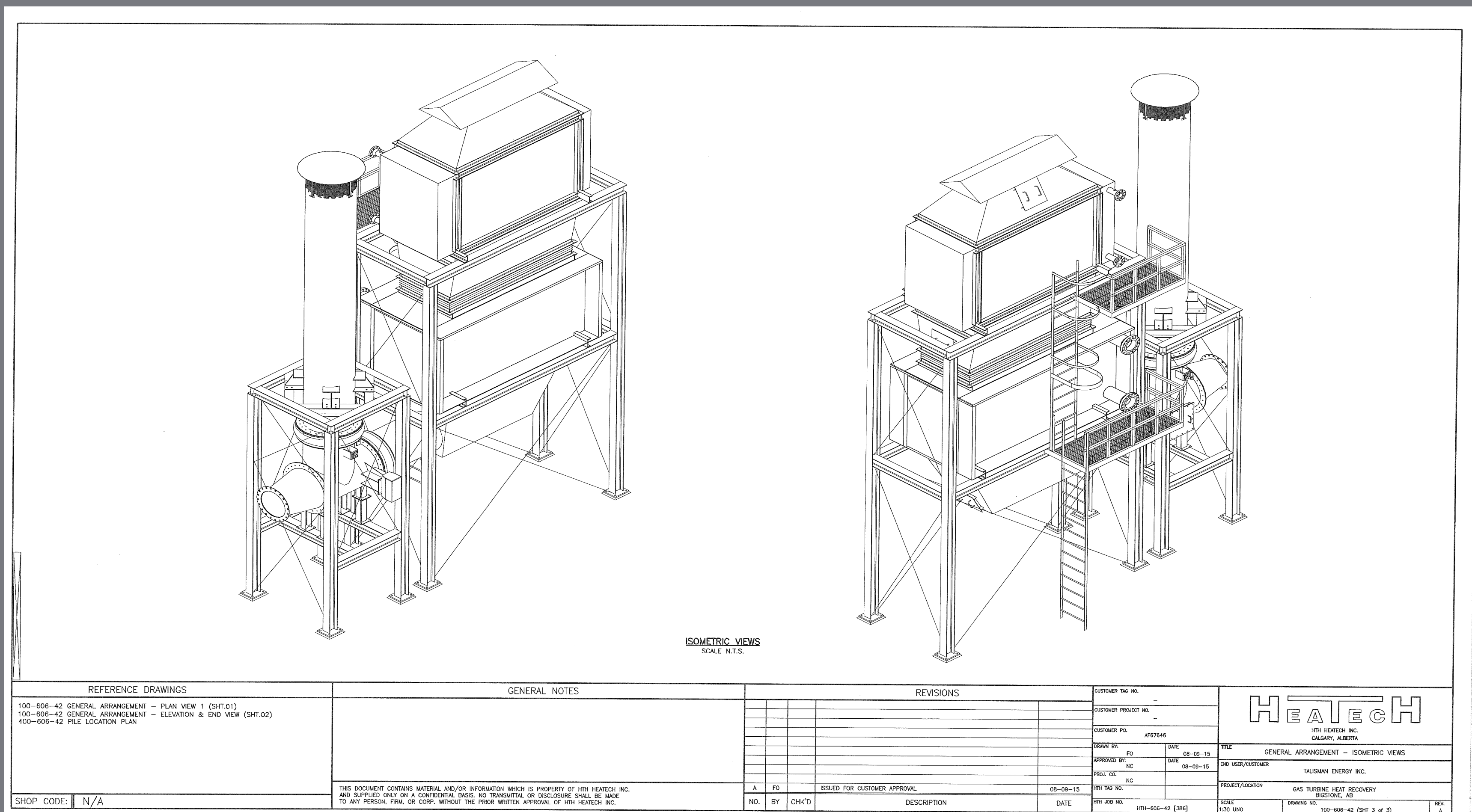
Challenges

- Incorporating the 2 fluids with different properties into one WHRU unit, presented unique control problems.
  - Installed damper on glycol system to provide secondary control
- Purge time of the WHRU stacks, went from 30 seconds to 5 minutes
  - Installed new starters to handle the incremental time
  - Tied starters into flare system
  - Installed burst plate in system
- Control system presented unique challenges
  - Lots of Hazop meetings to ensure that we provided proper protection
  - Installed many layers of protection

Installation- Site layout



Installation- Isometric



TALISMAN ENERGY

Installation

- Took advantage of previous outage to install all hot oil/glycol tie-in connections
- Installed WHRU complete with pilings, associated piping, and all instrumentation while Plant was on line
- Took advantage of scheduled outage to complete the final tie-ins which included :
  - Removing turbine exhaust stack and installing transition piece to connect WHRU to turbine exhaust
  - Commissioning of the EI Systems
  - Installed new Solar Turbine Starters and tied the starter exhaust into the flare system

TALISMAN ENERGY

WHRU Picture

TALISMAN
ENERGY

WHRU Picture

TALISMAN ENERGY

Summary – Benefits/Impact

- Utilization of Solar Turbine Sales Compressor exhaust waste heat to heat process liquids
- Replaces existing hot oil and glycol heat mediums, allows 2 line heaters to be shut in
- Maintains heat in buildings during winter by maintaining glycol temperature
- Reduction in fuel gas usage of 0.3 mmscf/day
- CO_2 reduction of 5,900 t/y
- N_2O reduction of 0.10 t/y
- Capital cost of $875k, payout of 2.0 years based on a fuel gas cost of $4.00 /mcf
- Potential of adding twin unit on 2nd Solar Turbine Compressor
- WHRU minimizes our environmental impact

TALISMAN ENERGY

Future Considerations

- Technology can be utilized elsewhere now that it has been proven
- This design could be added to the 2nd Solar Turbine Compressor at Bigstone if an application is identified
- Installation costs can be reduced due to having the upfront Engineering done– cost could range from $0.5 mm to 1.0 mm depending on application
- Future Turbine/ Centrigifugal Compressor installs could be justified based on installing WHRUs
- Reciprocal Compressor Applications -- Further research needed

TALISMAN ENERGY

Questions?

Thanks to the following people for their contributions and advice

Dave Pillage (Project Supervisor)
Yin Yanhua (Coop Student)
Liam Russel (Coop Student)
John Foxcroft (WP Engineering)
Noel Charchuk (Heatech)
Doug Kinas (Solar Turbine)

TALISMAN ENERGY