FEED Study for Carbon Capture Plant Retrofit to a Natural Gas-Fired Combined Cycle Plant

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Bill Elliott

Bechtel National Inc.

U.S. Department of Energy

National Energy Technology Laboratory

Carbon Capture Front End Engineering Design Studies and CarbonSafe

2020 Integrated Review Webinar

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Program Overview

- $1.54M total budget
  - Cost Share: 80% DOE, 20% Bechtel National Inc.
- Overall Project Performance Dates:

Milestone	Milestone Title and Description	Planned Completion Date	Forecasted Completion Date	Actual Completion Date
M1	Mobilization and Kick-off	12/9/2019	12/9/2019	15/11/2019
M2	Project Management Plan Submittal	1/13/2020	1/13/2020	1/8/2020
M3	Initial Process Engineering Design Package (DP)	3/30/2020	5/26/2020	5/21/2020
M4	Final Process Engineering DP and Initial Electrical, Automation Systems, Utilities and Other Engineering DP	5/30/2020	9/15/2020	
M5	Layout DP	6/30/2020	8/30/2020	
M6	Final Electrical, Automation Systems, Utilities and Other Engineering DP and Material Take-Off of Main Components DP	9/30/2020	10/30/2020	
M7	Final FEED Study Package and Cost Estimation DP	10/30/2020	12/31/2020	

Program Overview (continued)

- Project Participants:
  - Bill Elliott (Principle Investigator and Project Director)
  - August Benz (Principal Process Consultant)
  - Vinay Singh (Project Engineering Manager)
  - Martin Curtis (Lead Process Engineer)
  - Jon Gibbins (Lead Technical Consultant)
- Overall Project Objectives:
  - Utilize a low-cost generic solvent in design
  - Provide balances and process data details to public domain
  - Produce cost estimates and quantities that can be openly critiqued
  - Provide operation economics consistent with actual operating regimes with Electric Reliability Council of Texas (ERCOT)
  - Provide an implementation scenario consistent with prudent investment planning

Technology and Site Selection

Technology and Site Selection

- MEA open technology-based post combustion absorption of CO_2 at a gas fired combined cycle power plant.
- Commercially available proven technology
- Panda Sherman 2x2x1 plant selection based on:
  - Knowledge of Plant
  - Owner's support
  - Space availability

Technology and Site Selection

- Site selection based on economic, transportation, and storage considerations:
  - Future CO_2 pipeline likely close to the power plant
  - Saline basins in the area for CO_2 sequestration
  - Oil fields in vicinity – potential use of CO_2 in enhanced oil recovery
  - Low gas price

Technical Approach/Project Scope

a. Key Milestones:

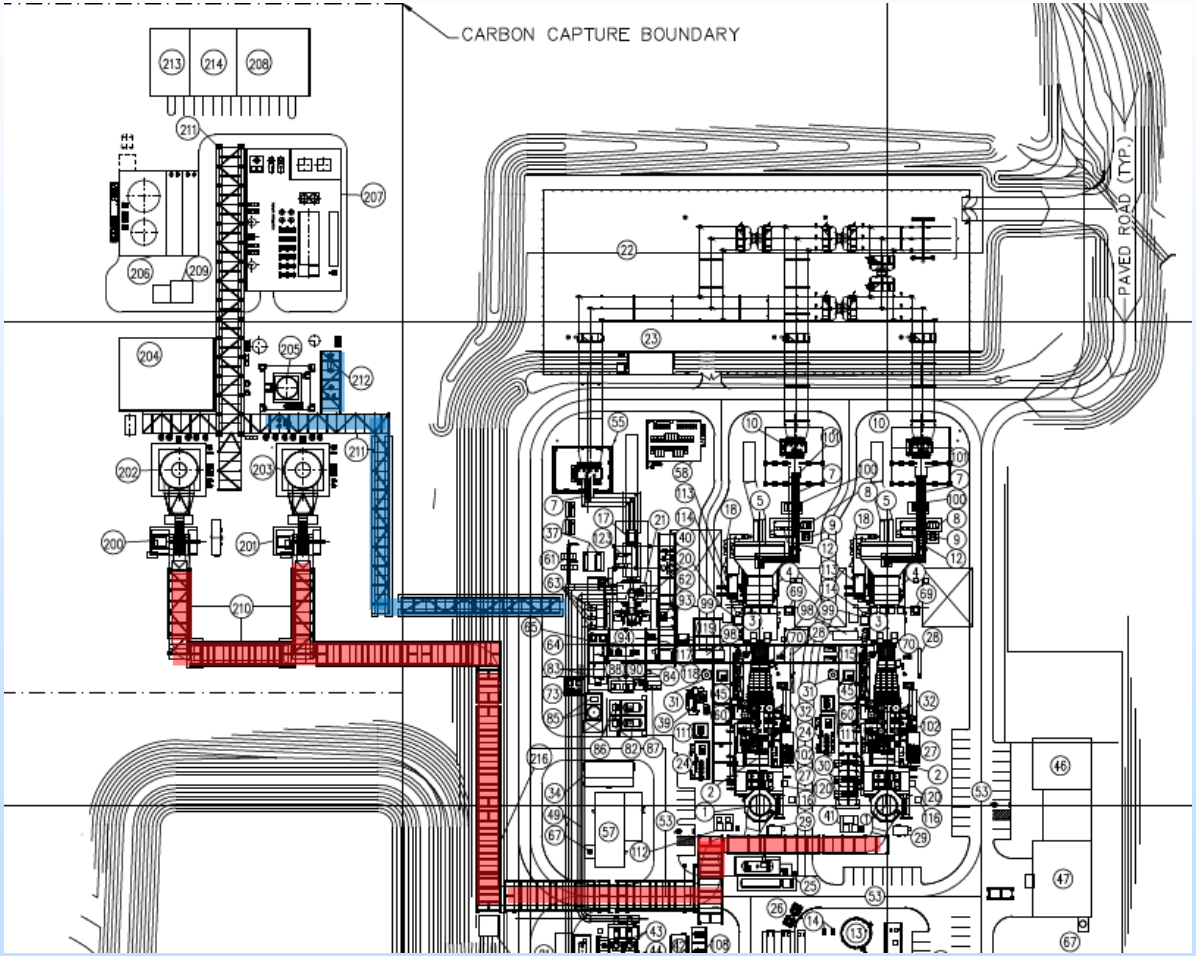
Milestone	Date (Actual or Forecast)
Issue Process P&IDs, PFDs, HMB	**8-Aug (A)**
Electrical Design	**15-Oct**
HAZOP	**21-Oct**
Layout and Model	**30-Oct**
Cost Estimate	**30-Nov**
Preliminary Report	**15-Dec**

Technical Approach/Project Scope

b. Project success criteria
   a. Provide generic design available for public use, based on MEA
   b. No technological gaps
   c. Reliability of overall project cost within +/- 20%
   d. On-time completion

c. Significant project risks - Mitigation strategies
   a. Noise exceeding current permit limits – Building, enclosures, or sound absorbing barriers around equipment
   b. Client change of mind based on economic analysis – Change project location
   c. Usage demand (EOR) – Move to saline sequestration

Progress and Current Status of Project



Integrated Plot Plan

Sherman Plant Data without Carbon Capture at 35°C and 43% RH

	Fired Case	Unfired Case
MW- Gross, MW	740.6	614.2
MW-Net, MW	719.2	594.1
Flue Gas, kg/hr	3,964,553	3,700,044
Flue Gas, m3/hr	4,187,800	3,982,520
Flue Gas Temp, °C	84.6	92.3
Saturation Temp, °C	~48	~48

Sherman Flue Gas Composition (Unfired Case)

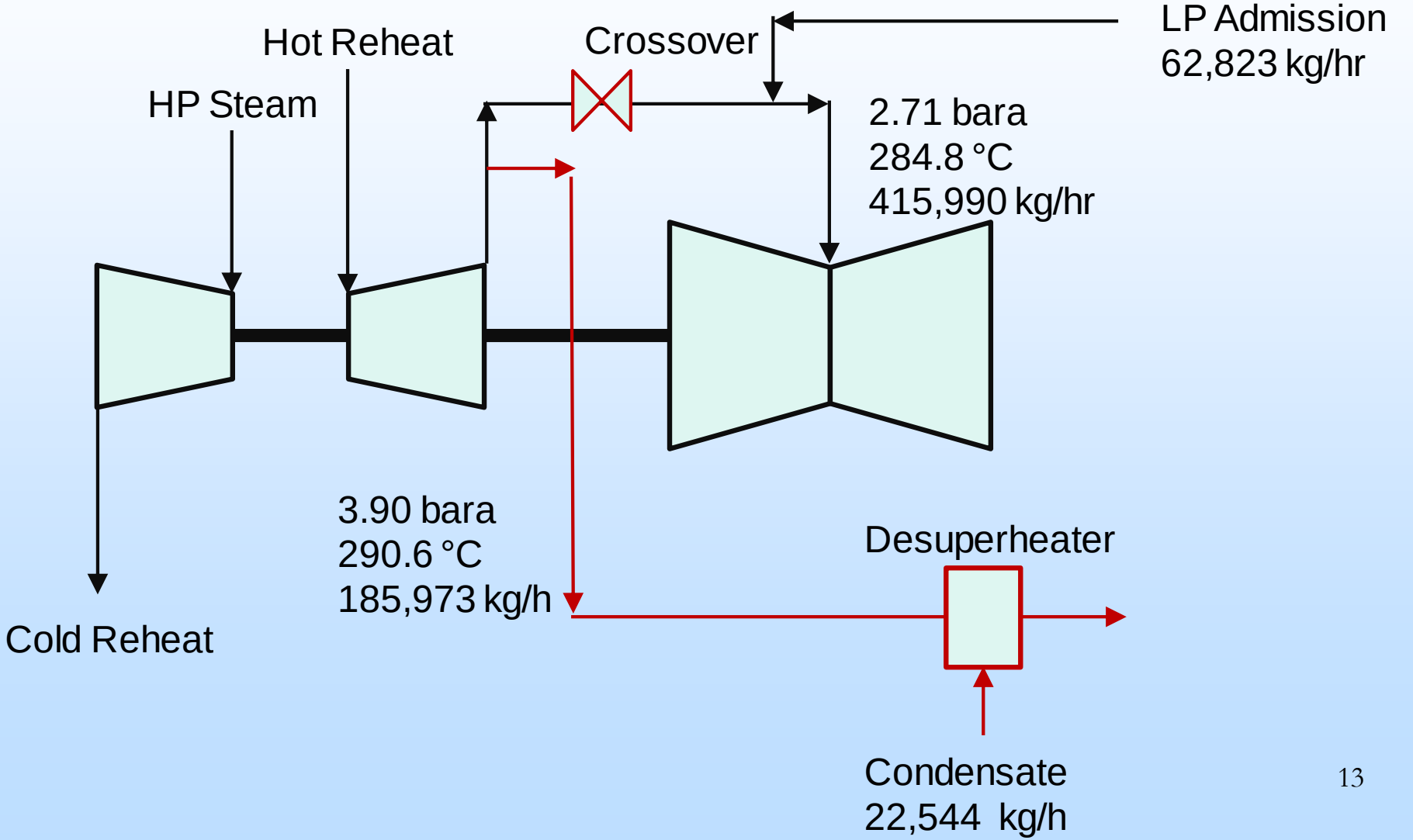
	Vol, %	Wt. %
CO2	**3.76**	**5.87**
N_2	72.97	72.52
H_2O	10.20	6.52
O_2	12.22	13.87
Ar	0.86	1.21

Sherman Cross-Over Line Conditions (Summer Operation)

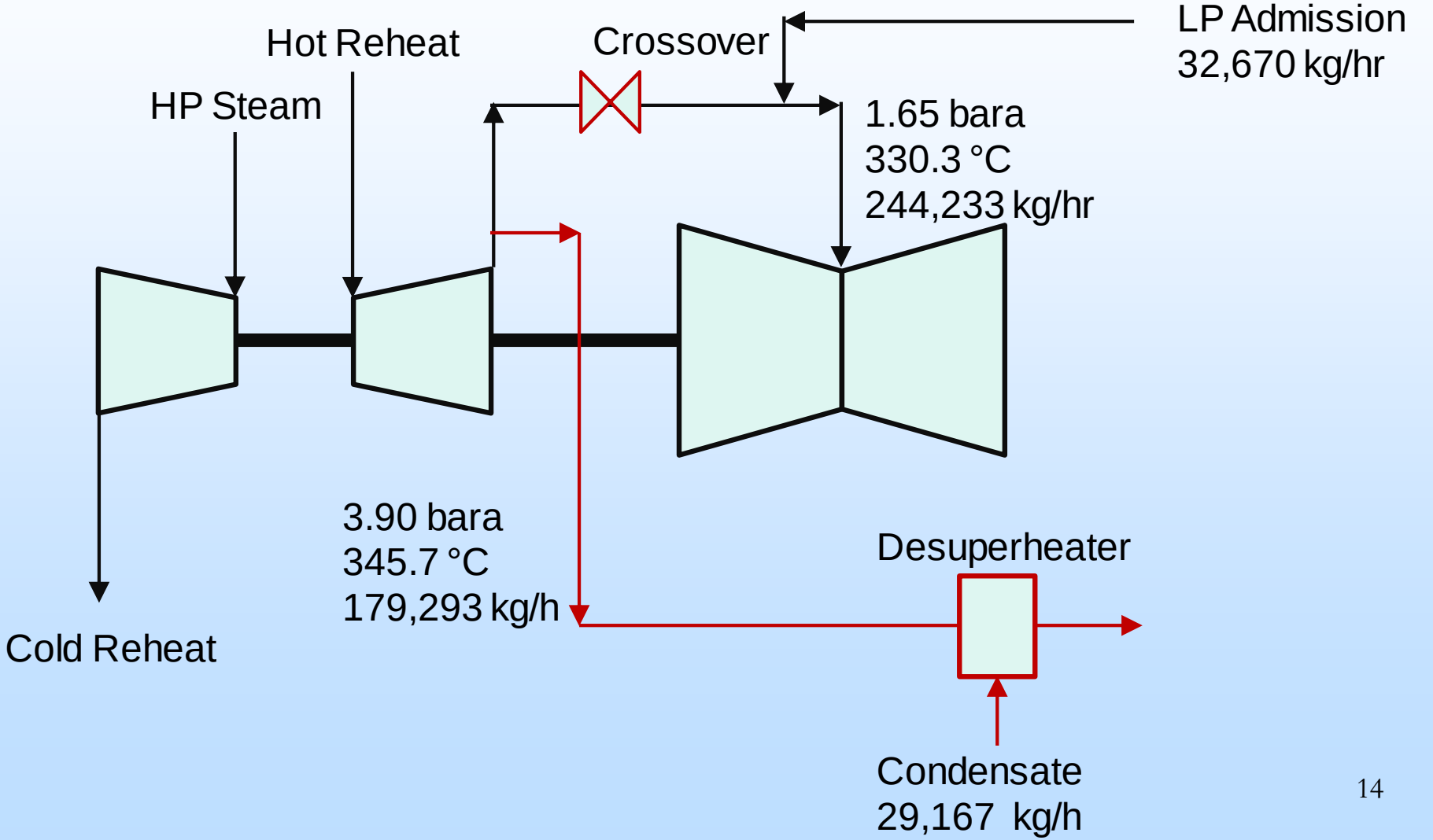
Load,%	P(bara) / T(°C) Extrac. Steam	Steam Flow, kg/hr IP Exh / Extr. / To LP Turb*
100 (2 GTs)	3.90 / 290.6	539,140 / 185,973 / 415,990
2GTs at 60%	3.90 / 345.7	390.856 / 179,293 / 244,233
1GT at 100%	4.24 / 391	274,707 / 174,032 / 127,900

* Flow to LP steam turbine includes additional LP steam from the HRSG.

Sherman Cross-Over Line Conditions (2x2x1, 100% Unfired)

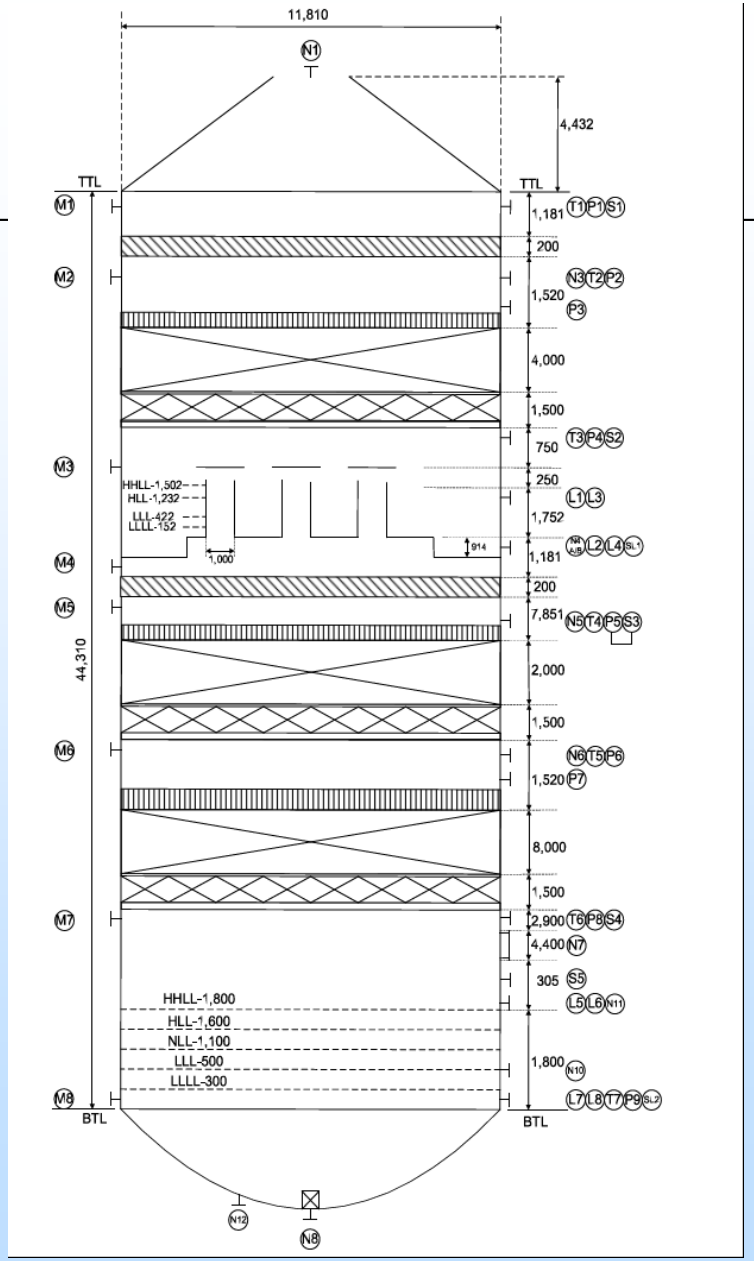


Sherman Cross-Over Line Conditions (2x2x1, 60%)

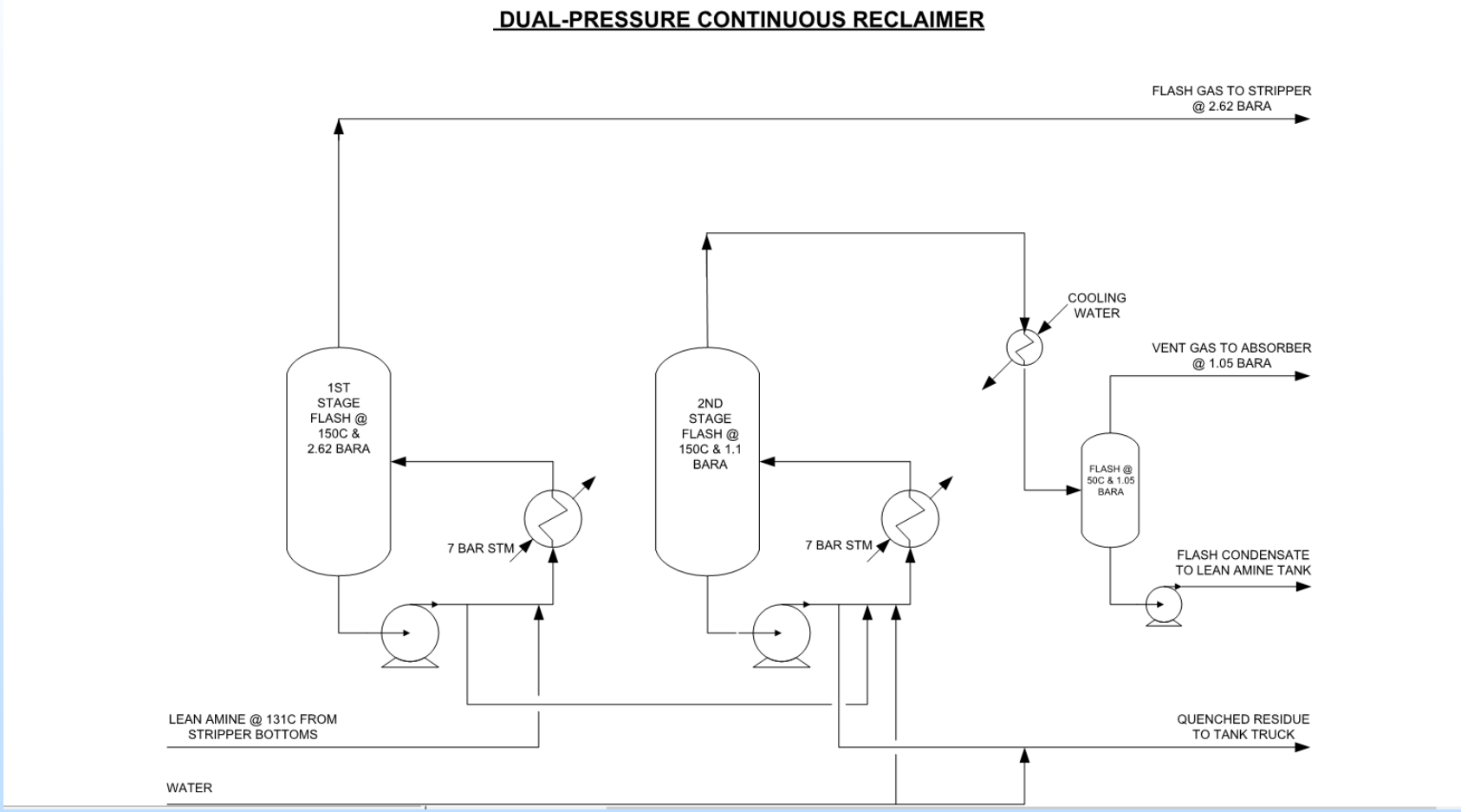


Absorber

- Two Absorber Vessels
- Two Absorption Beds
- Water wash and demister sections
- Straight length: 44.3m
  Diameter: 11.8m



Reclaimer


DUAL-PRESSURE CONTINUOUS RECLAIMER
FLASH GAS TO STRIPPER @ 2.62 BARA
COOLING WATER
VENT GAS TO ABSORBER @ 1.05 BARA
1ST STAGE FLASH @ 150C & 2.62 BARA
2ND STAGE FLASH @ 150C & 1.1 BARA
FLASH @ 50C & 1.05 BARA
7 BAR STM
7 BAR STM
FLASH CONDENSATE TO LEAN AMINE TANK
LEAN AMINE @ 131C FROM STRIPPER BOTTOMS
QUENCHED RESIDUE TO TANK TRUCK
WATER

Summary Slide

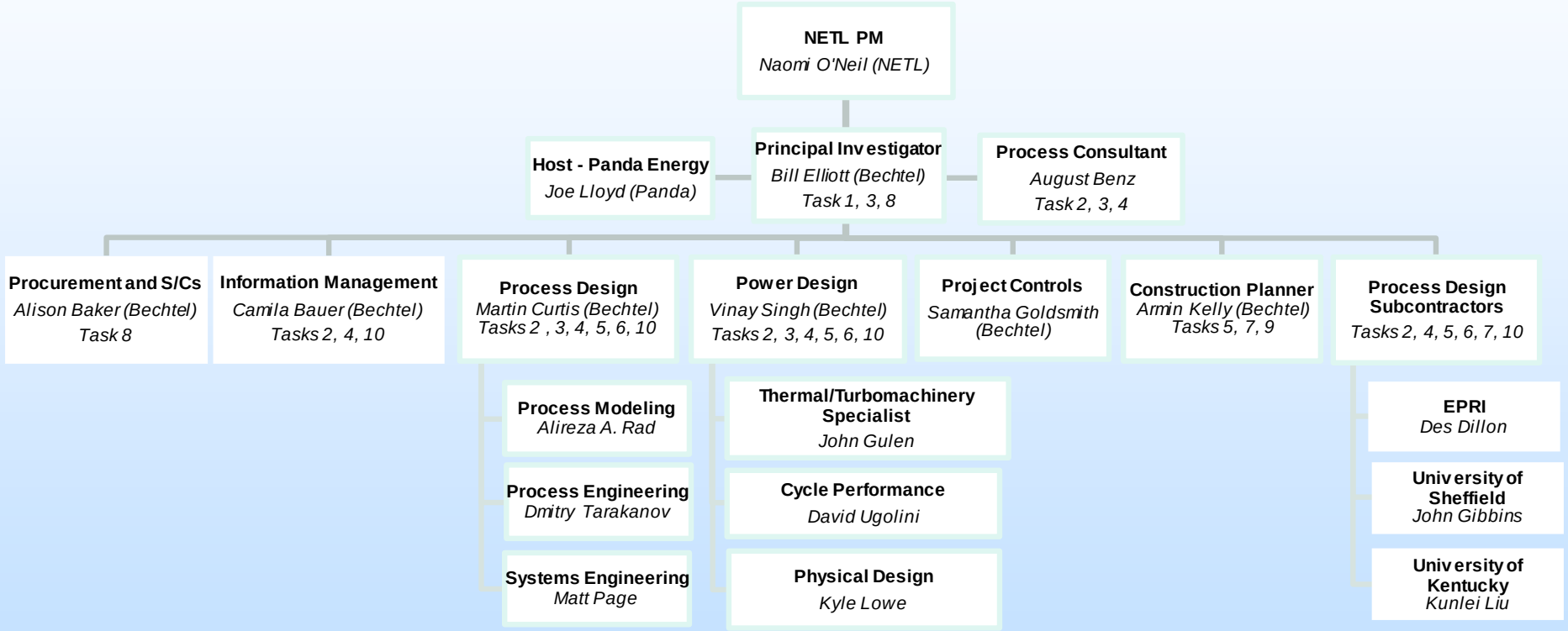
a. Summary:
   - Process Design: Finalized Process Design Package including PFDs, HMB, and P&IDs. Reclaimer design is under review.
   - Retrofit Design: Significant progress in steam and cooling water supply system designs, routing of flue gas and utilities, and integrated plot plan.
   - Cost: MRs being issued to obtain pricing of major equipment

b. Future Plans:
   - Finalize Reclaimer Design
   - Finalize HAZOP and HAZID
   - Complete cost estimate

Appendix

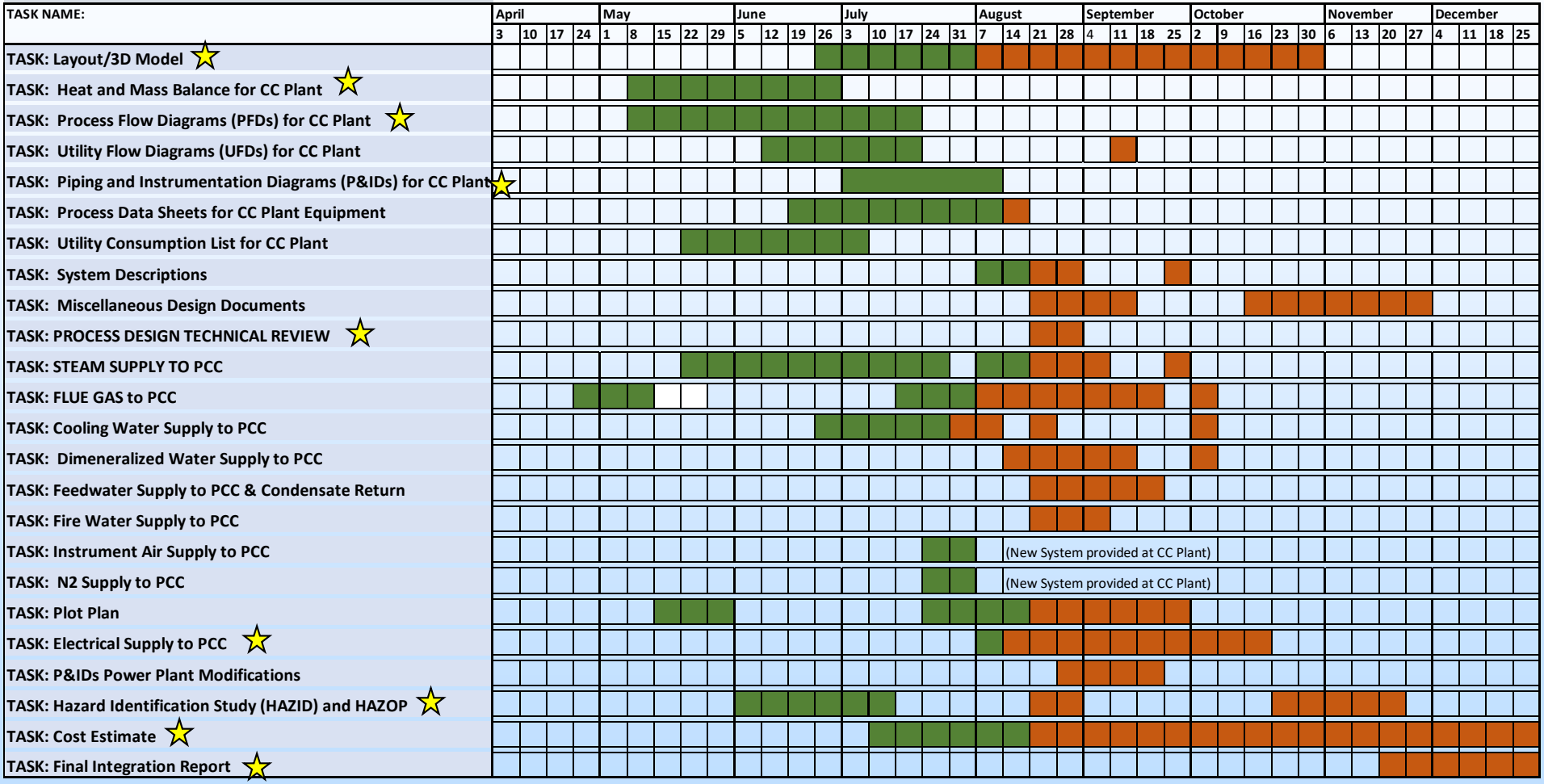
- Organization Chart, Slide 19
- Gantt Chart, Slide 20

Organization Chart



Gantt Chart

DOE SHERMAN SCHEDULE



Actual Forecast Key Milestone