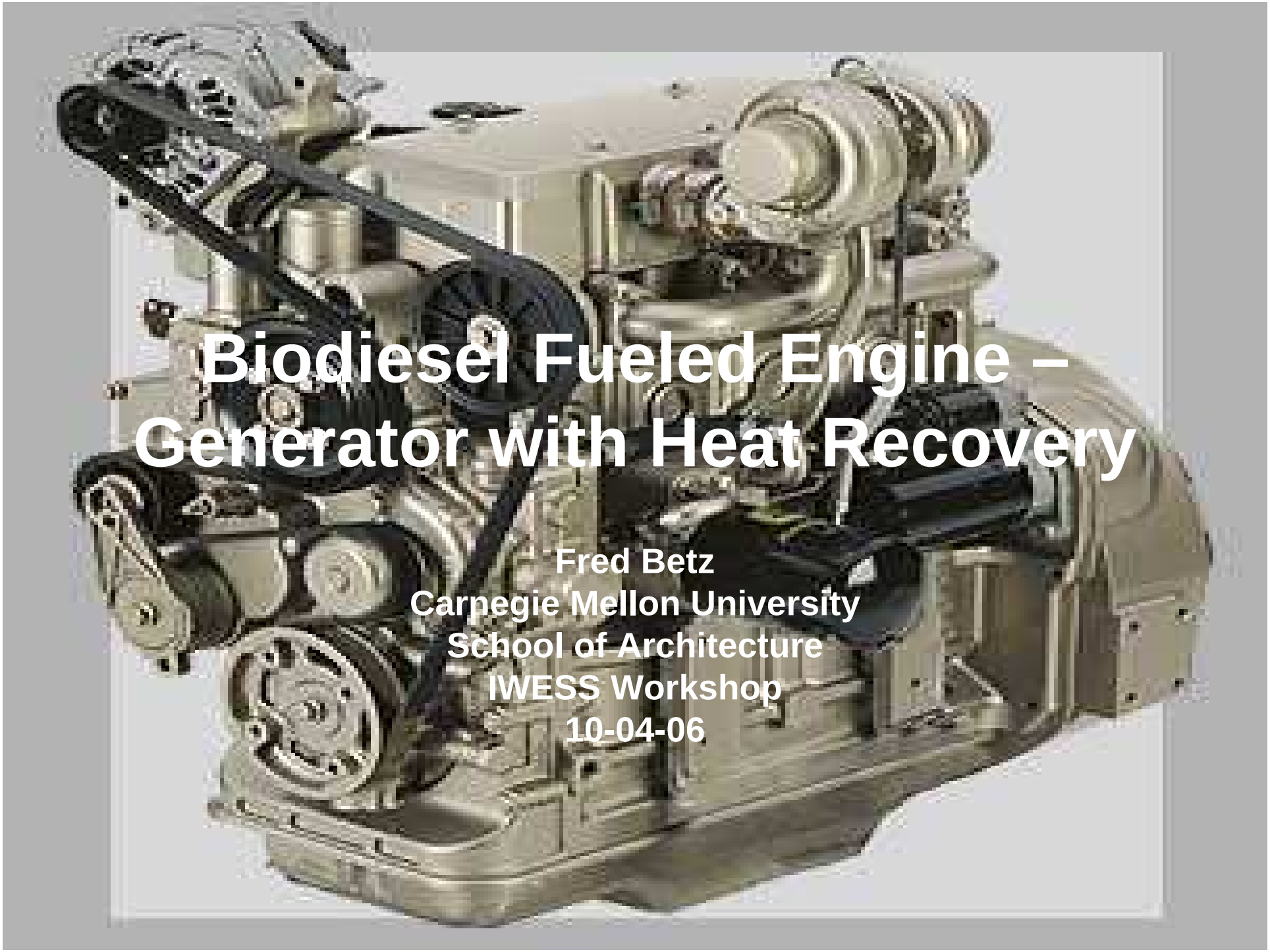

Biodiesel Fueled Engine – Generator with Heat Recovery

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IWESS Workshop
10-04-06

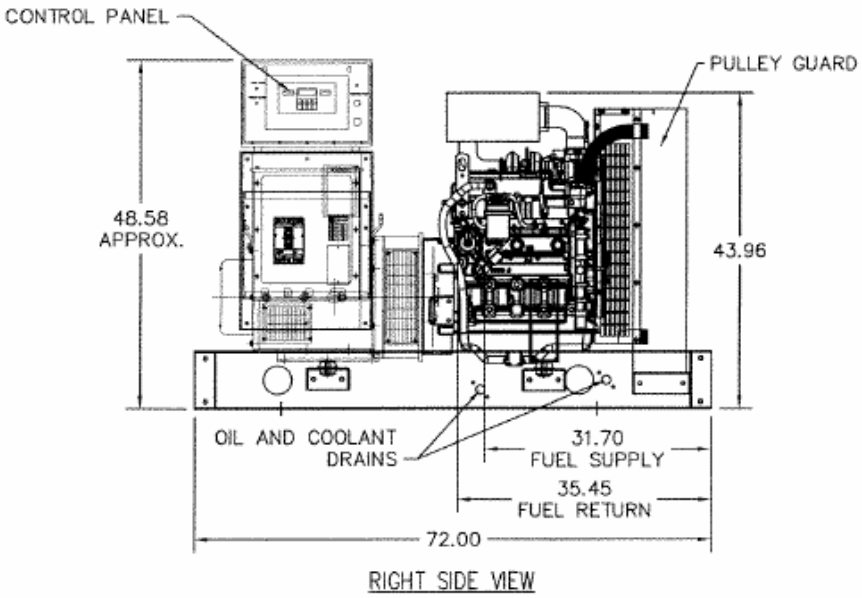
Introduction

- Demonstrate use of renewable fuel and heat recovery.

- Assess the effectiveness and efficiency of meeting power, heat, and cooling requirements of the IW.

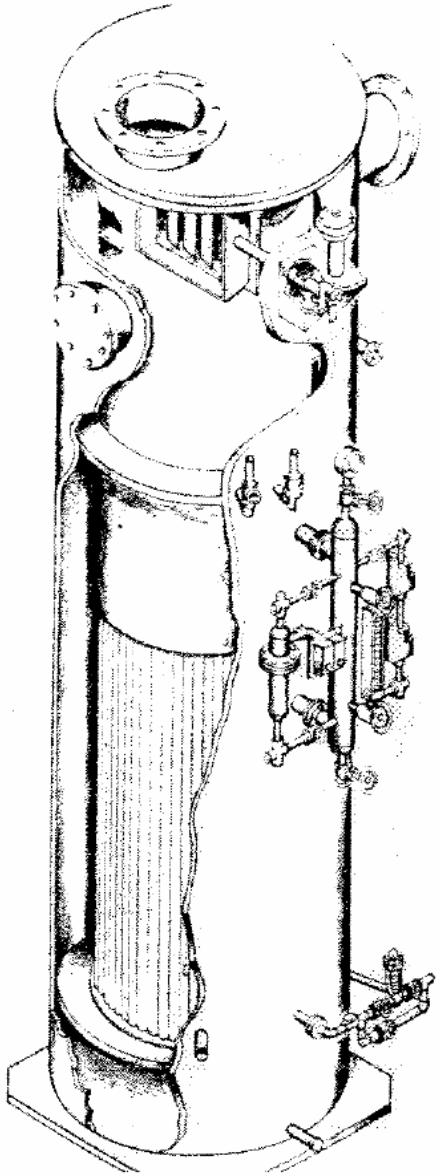
Engine – Generator Specifications

- Engine
  - John Deere 4024
  - Turbocharged
  - 32 kW shaft power
  - 20 kW hot water
  - 18 kW steam
- Generator
  - Baldor
  - 25 kW electric
  - 220 Volt, 3phase
  - Grid interconnected
- Overall Dimensions
  - 72” Long
  - 42” Wide
  - 48” Tall



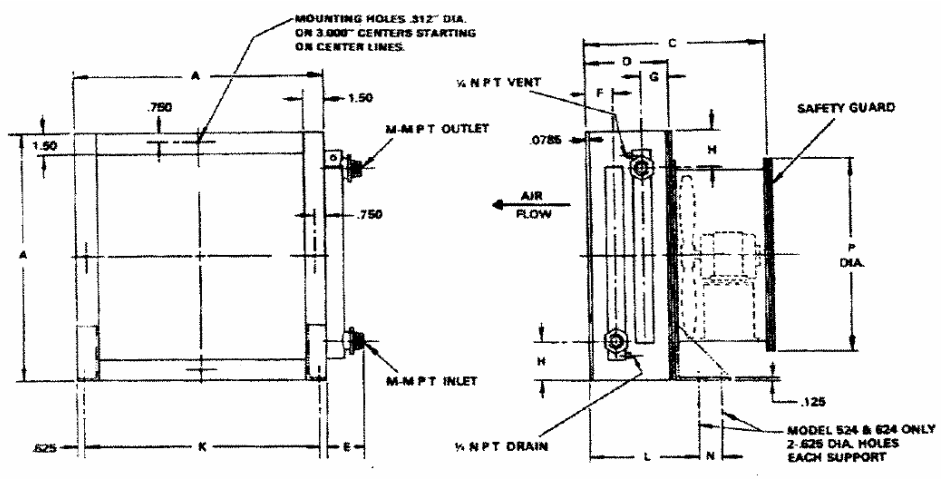
Heat Recovery Specifications

- Exhaust heat recovery
  - Vaporphase steam generator
  - 30.4 kg/hr (67.1 lb/hr)
  - 7 bar abs (87 PSIG)
  - Connected to:
    - Broad steam driven absorption chiller
    - existing steam converter
- Overall Dimensions
  - 132” Long
  - 36” Dia.



Heat Recovery Specifications

- Coolant heat exchanger
  - ITT plate & frame
  - Engine coolant to water
  - 24 GPM
  - Connected to:
    - Semco solid desiccant dehumidification system
    - IW hot water loop

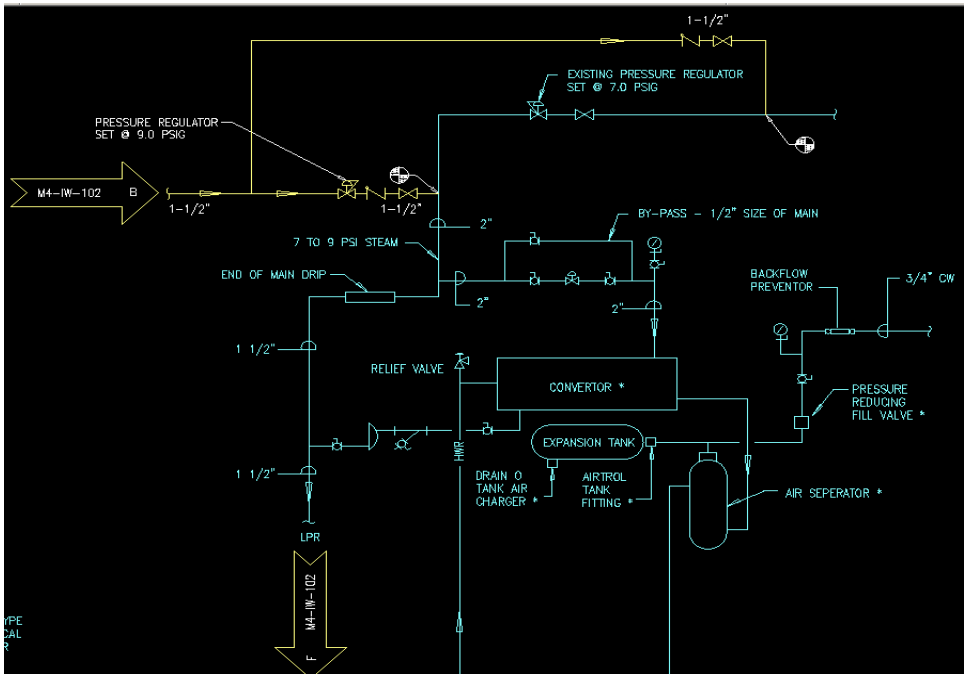


All dimensions are in inches unless otherwise indicated. Dimensions are not guaranteed unless certified.

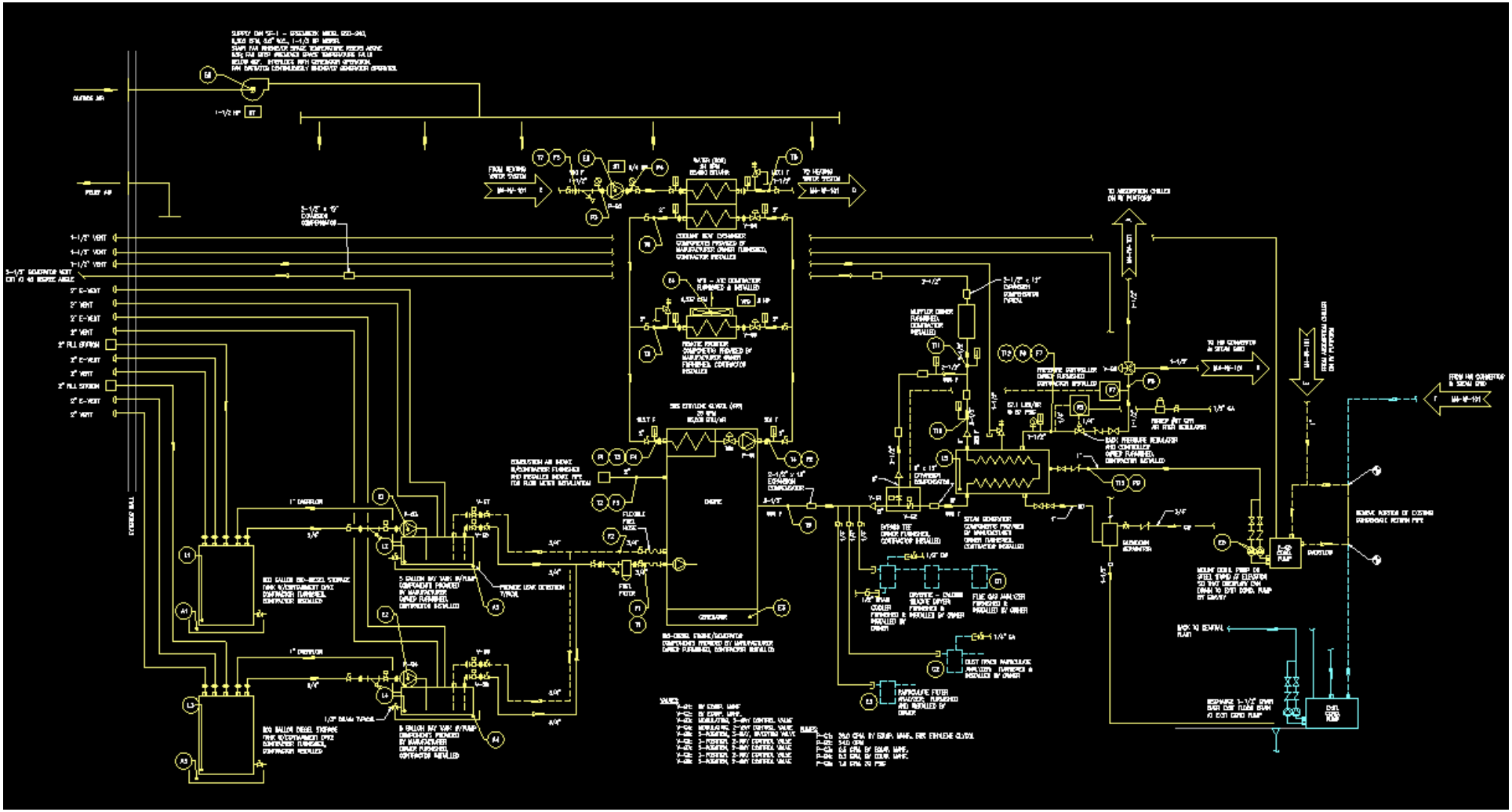
MODEL NO.	A	C	D	E	F	G	H	K	L	M	N	P	PART NUMBER	WEIGHT LBS.	MOTOR H.P.	MOTOR R.P.M.
224	25.5	21.9	8.0	3.8	2.5	2.5	3.0	—	—	1½	—	25.0	5-740-22-022-002	150	½	1750
274	30.5	22.9	9.0	3.8	2.5	3.5	3.0	—	—	1½	—	25.0	5-740-27-027-003	184	¾	1750
324	35.5	24.5	9.5	4.4	2.5	4.0	3.0	—	—	2	—	34.8	5-740-32-032-003	250	2	1750
374	40.5	25.0	9.0	4.4	2.5	3.5	3.0	—	—	2	—	35.8	5-740-37-037-003	325	3	1750
424	45.5	25.0	9.0	4.4	2.5	3.5	3.0	—	—	2	—	38.0	5-740-42-042-003	373	3	1750
474	50.5	27.0	11.0	4.4	2.5	5.5	3.0	—	—	2	—	38.0	5-740-47-047-003	437	3	1750
524	55.5	31.2	10.5	5.5	2.3	4.8	3.2	54.2	12.9	2½	12.0	44.0	5-740-52-052-003	540	5	1750
624	65.5	32.8	12.0	5.5	2.3	6.3	3.2	64.2	14.4	2½	15.0	50.0	5-740-62-062-003	740	5	1160

Heat Recovery Specifications

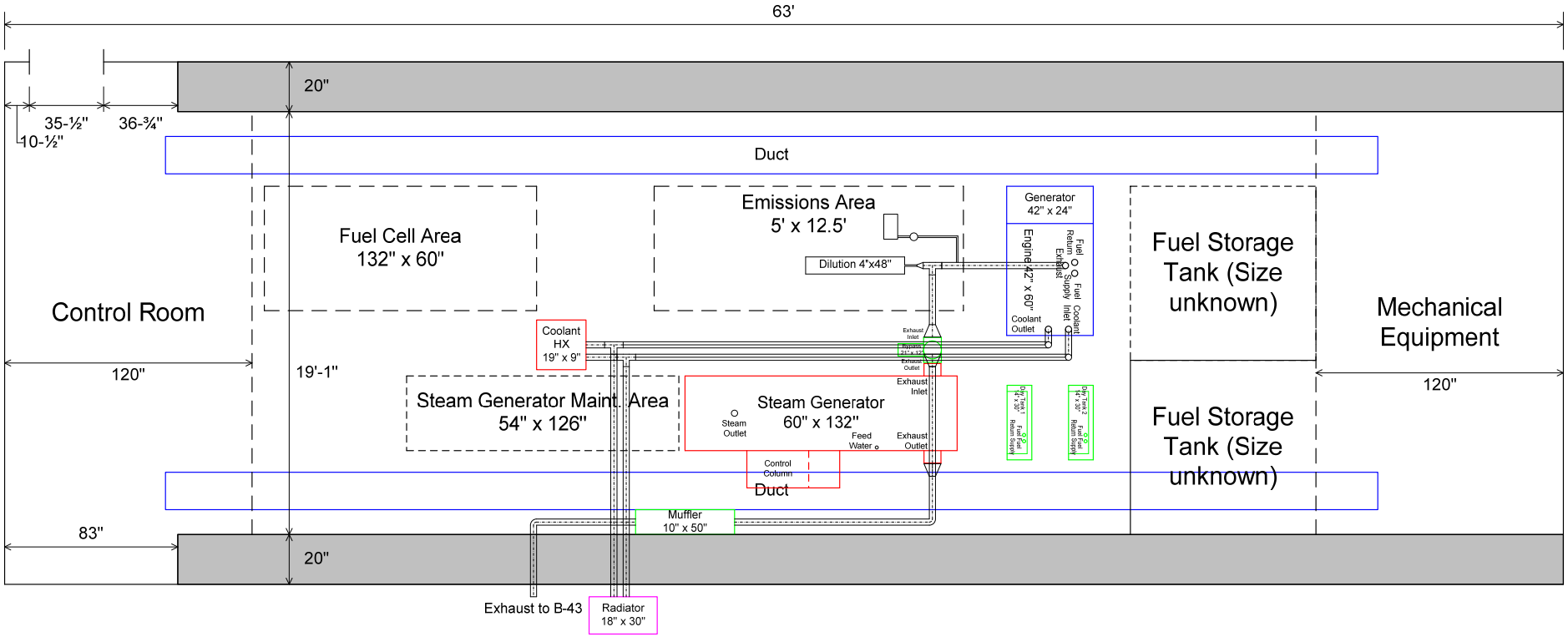
- Steam Converter
  - Existing system that provides hot water to the IW from the campus steam grid
  - Will be connected to the steam generator



System Flow Diagram



Preliminary Layout



System Installation / Commissioning

- Equipment arrives December 2006
- Site preparation begins November 2006
- Installation complete March 2007
- Commissioning begins shortly thereafter

System Operation

- Cooling Season
  - Exhaust gas supplies steam for the Broad absorption chiller.
  - Coolant supplies hot water for regenerating the desiccant Semco ventilation unit.
- Heat Season
  - Exhaust gas supplies steam to the hot water converter.
  - Coolant suppies hot water for the IW hot water loop

System Operation

- Swing Season
  - Exhaust gas supplies steam to the campus grid.
  - Coolant supplies hot water for regenerating the desiccant of the Semco ventilation unit or provide space heating in the IW.
  - Coolant energy may also be rejected via the remote radiator.

Biodiesel Fuel Testing

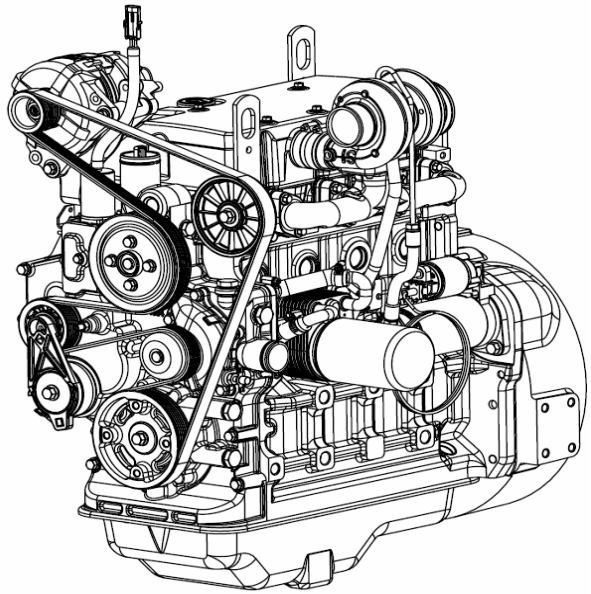
- Supplied by CTI Biofuels, Pittsburgh, PA
- Four B100 fuels from different feedstocks
- Determine max capacity (fuel flow, smoke limit)
- Four load settings: 100%, 75%, 50%, 25% of design, 25 kWe
- ~100 gallons of each fuel will provide approximately 40 hours of operation at design load.
- Calculate efficiency and determine heat production.

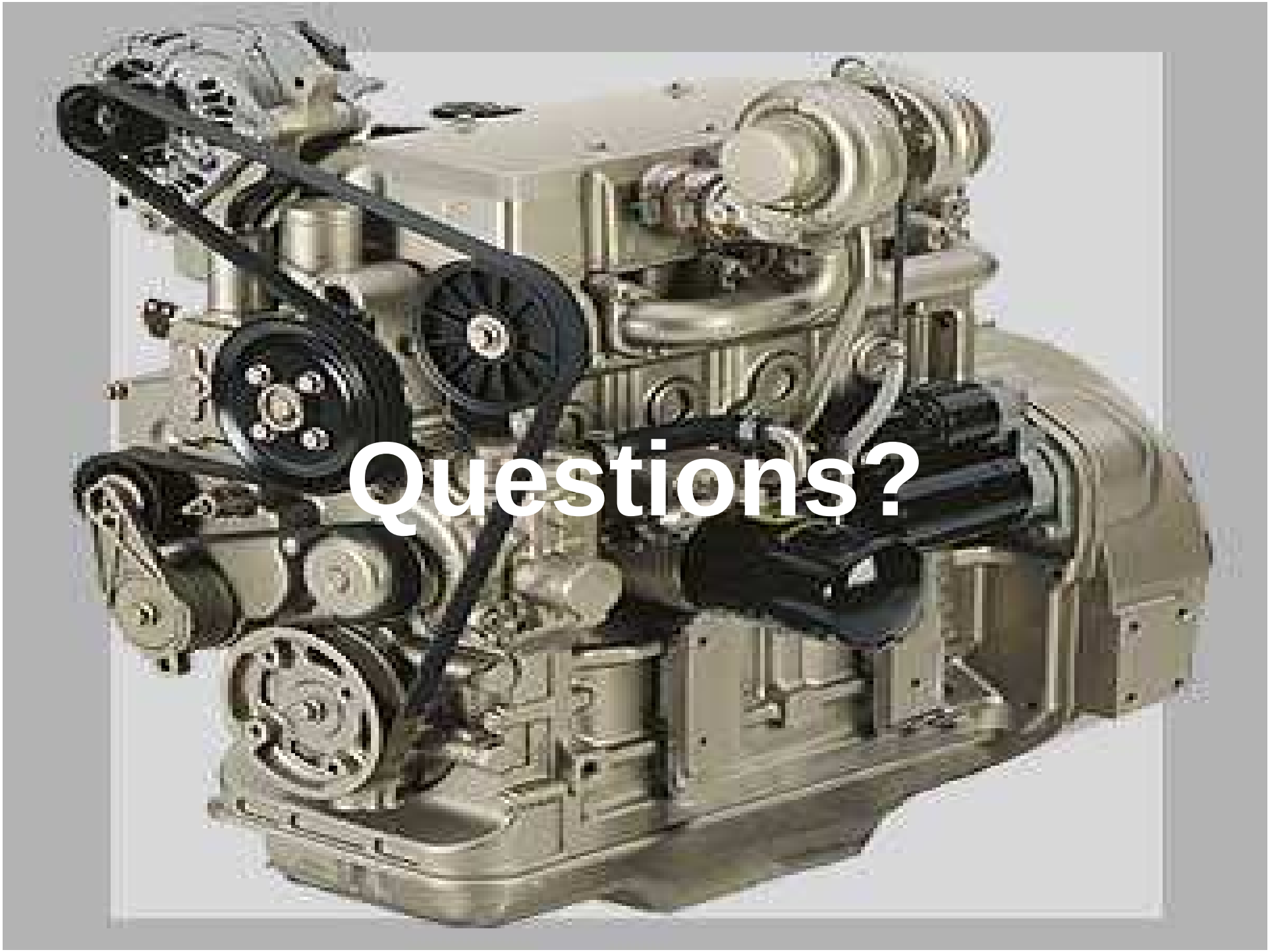
Emissions Monitoring

- Nova exhaust gas analyzer monitors:
  - O2, NOx, CO2, CO, HC
- Dustrak monitors:
  - 0.0 to 1.0 micron particulate matter
- Filter paper collects:
  - Particulate matter for detailed analysis in “Center for Atmospheric Particulates Studies” in the Mechanical Engineering Department.
  - Testing will focus on organic compounds.

Future Work

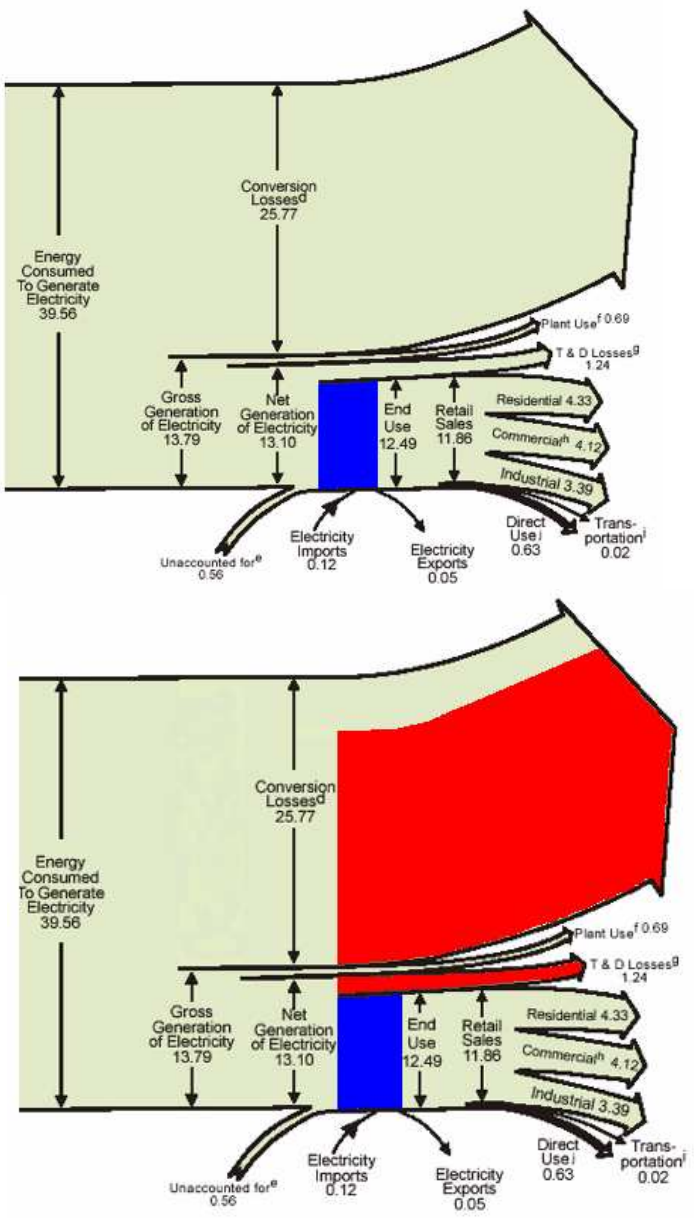
- Equipment will be ready for testing in April.
- Demonstrate
  - use of renewable fuel to meet power, heating, and cooling loads of the IW
  - overall efficiency approaching 80%
- Test program laid out to measure system and environmental performance




Questions?

Advantage of Cogeneration

- Standard large power plants have an efficiency of 30% plus a 3 percentage point loss for transmission.
- Distributed generation with CHP can achieve an efficiency of 80%.



Ref: EIA: 2002 US Electrical Energy Flow

Engine Technical Drawing