BIOMASS ENERGY: AVOIDING COMMON MISTAKES IN ENGINEERING AND CONSTRUCTION

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Alaska-Yukon Wood Energy Conference

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Our Mission

We outfit communities and businesses with state-of-the-art biomass energy systems that strengthen local economies, lower energy costs and promote environmental stewardship.

Technology in Service of Community and Environment

ABOUT WISEWOOD ENERGY

- **Project Development:** Project planning, project finance, fuel supply contracts, third-party owned thermal energy generation assets
- **Design/Build:** Biomass energy installations including complete system engineering, procurement and construction (EPC)
- **Technical Consulting:** Feasibility studies, financial modelling, and project management
- **Territory:** OR, WA, AK, CA, ID, MT, CO

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COMMON ENGINEERING MISTAKES

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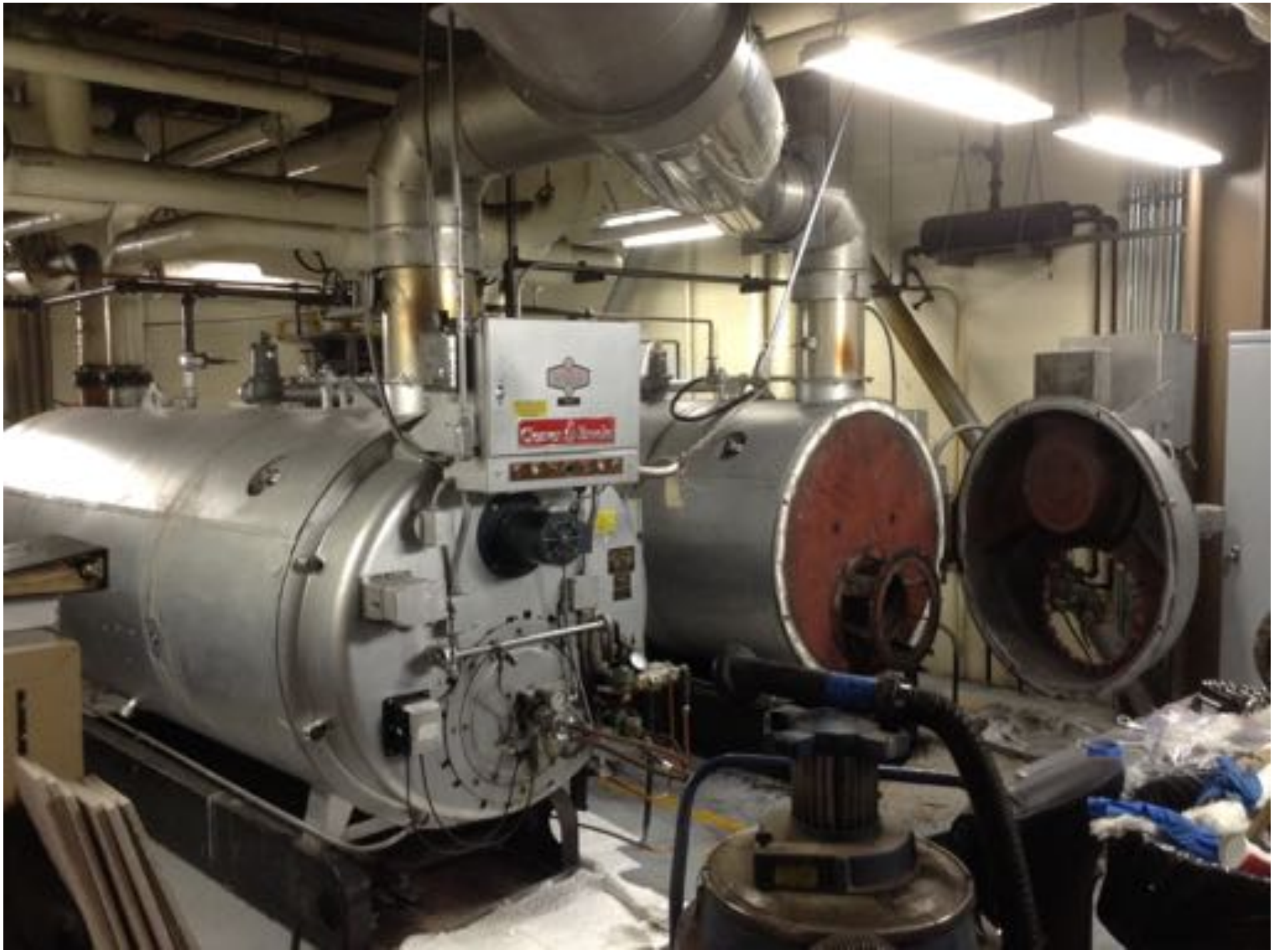
- Oversized Boilers
- Fuel Quality / Fuel Handling / Combustion System Mismatch
- Improper Hydronic Design
- Inadequate Thermal Storage
- Poor Controls Integration/Intrusive Controls

OVERSIZED BOILERS

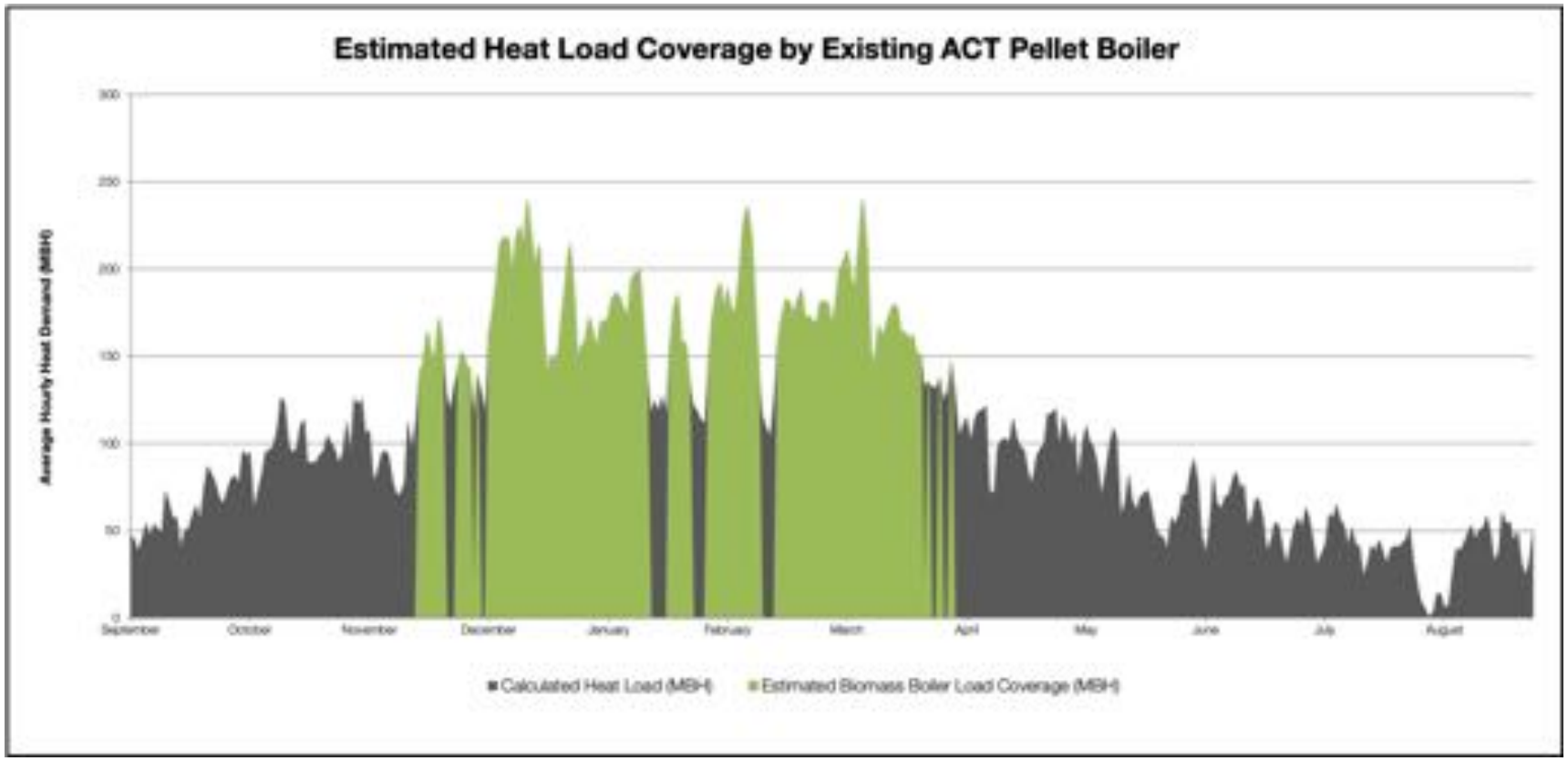
- **Fossil fuel boilers typically grossly oversized for the heat load.**
- **Typically 2-5x or even 10x oversized**
- **Example Ketchikan Airport**
  - Existing Boilers = 2 x 3,300 MBH
  - New Wood Pellet = 1 x 500 MBH
  - New Backup Oil = 1x 1,000 MBH
  - 6,600 MBH replaced by 1,500 MBH
  - Original boilers ~ 4.4x oversized



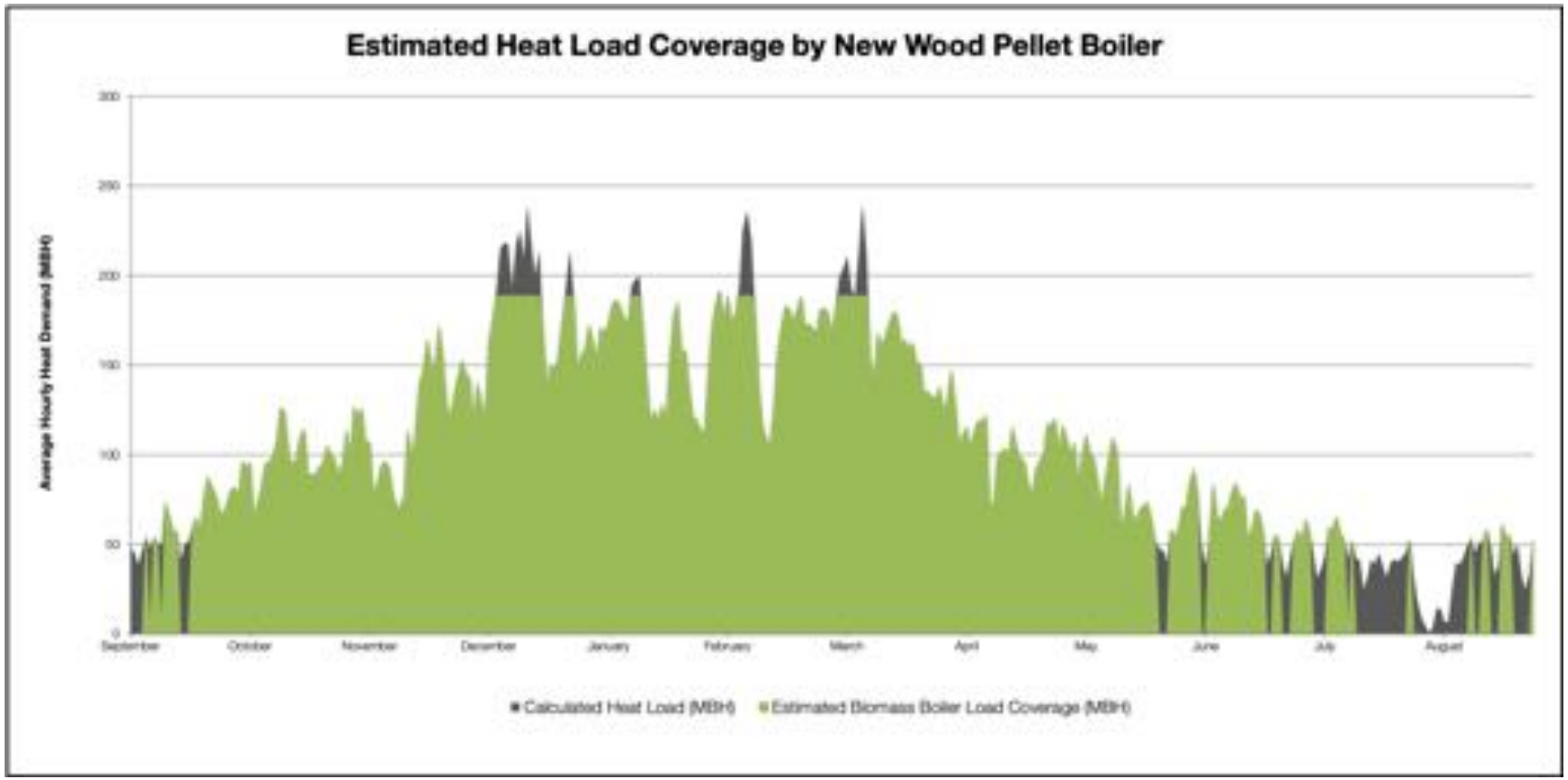
OVERSIZED BOILERS

- **Oil/Gas/Elec boilers react quickly so oversizing is not usually problematic**
- **Biomass boiler react very slowly**
- **Example Ketchikan Library**
  - New built system with biomass boiler sized for 100% of load
  - In reality, after three years of operation boiler is 200% of load

EXISTING PELLET BOILER (500 MBH)



NEW PELLET BOILER (190 MBH)



FUEL QUALITY / COMBUSTION SYTEM MISMATCH

- Fuel quality is defined by moisture content, particle size, ash and fines content
- Most boilers designed for a fairly narrow range of fuel types
- Problems arise when a project is designed around one fuel spec, but actual delivered fuel is different
- Can lead to combustion issues, fuel feeding problems, slagging and clinker formation

FUEL QUALITY - MOISTURE


14.27 %
MB
Data Support Co., Inc.
800-726-5883 www.dscbalances.com
OHAUS
→T←


74.27%
BIN 1
2/8/19
61.70%
BIN 2
2/8/19

FUEL QUALITY – PARTICLE SIZE

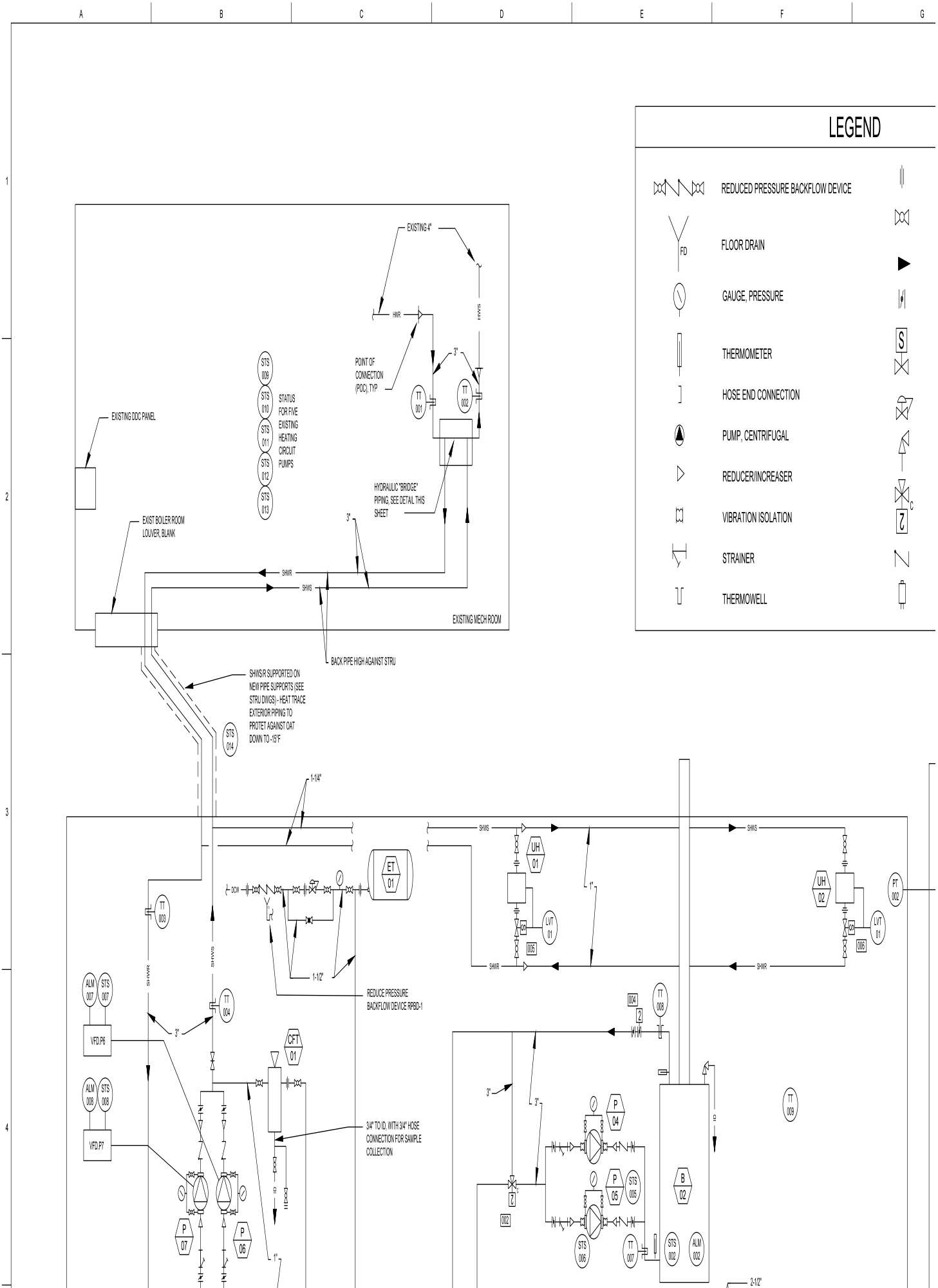
FUEL QUALITY – ASH CONTENT

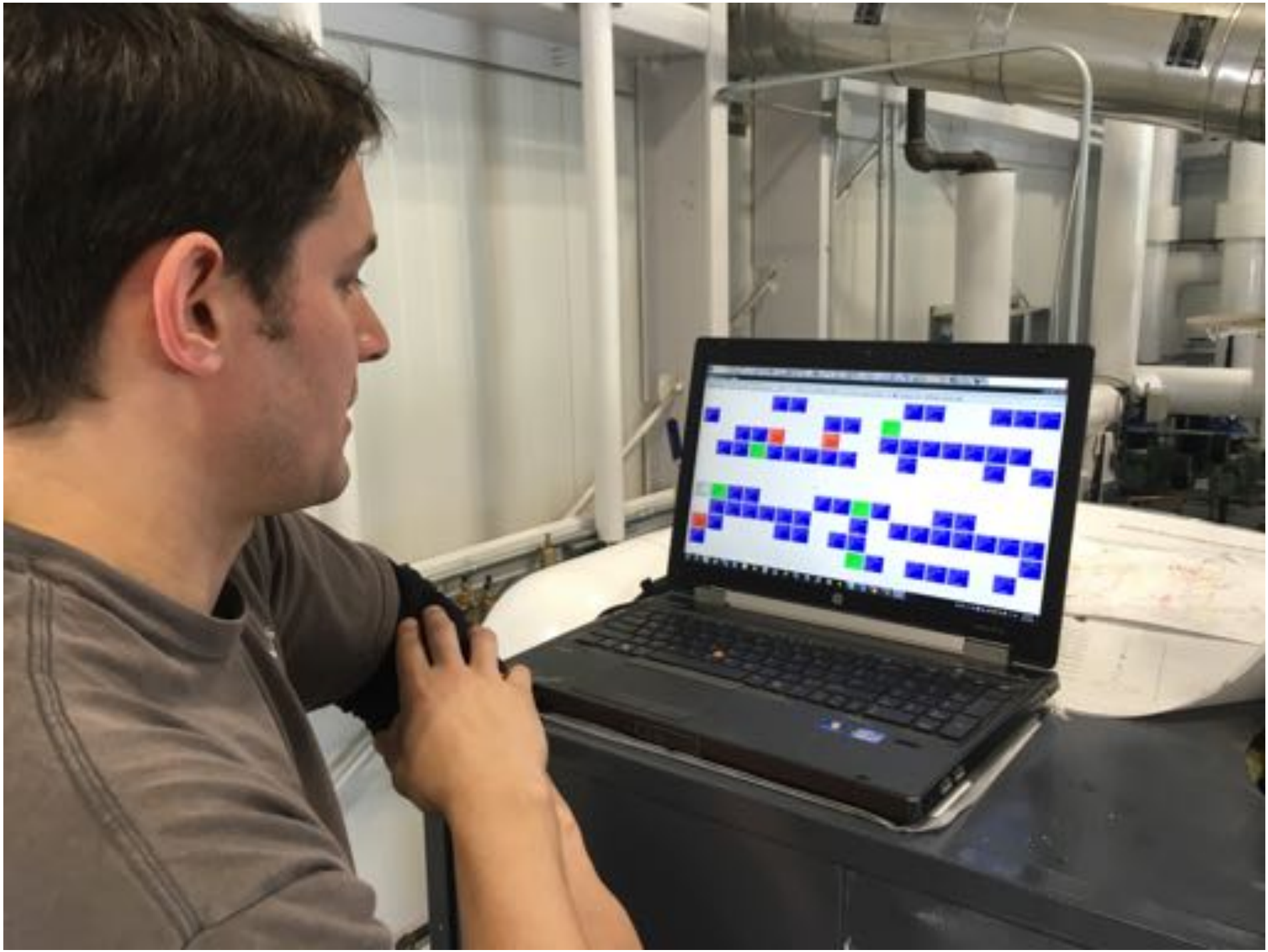
HYDRONIC DESIGN

- **Elements of good hydronic design for biomass include:**
  - Buffer tanks between biomass boiler and load
    - Dampens fluctuation, decreases short cycling
  - Hydraulic separation
    - Via closely coupled Ts and Low loss headers
  - Modulation
    - VFD driven pumps
  - Thermal protection
    - Thermostatic mixing valves for boilers

CONTROL DESIGN/INTEGRATION

- **Elements of good control design for biomass include:**
  - Allow boiler vendor to control all systems up to the buffer tank
    - They should know best how to handle fuel feed, firing controls, tank loading
  - Balance of system should treat the buffer tank as the boiler
    - Buffer tank can respond to the load like a conventional boiler, allow biomass boiler "do its thing" without interferance


LEGEND
REDUCED PRESSURE BACKFLOW DEVICE
FLOOR DRAIN
GAUGE, PRESSURE
THERMOMETER
HOSE END CONNECTION
PUMP, CENTRIFUGAL
REDUCER/INCREASER
VIBRATION ISOLATION
STRAINER
THERMOWELL
EXISTING 4"
HWR
HWS
3"
POINT OF CONNECTION (POC), TYP
TT 001
TT 002
STS 009
STS 010
STS 011
STS 012
STS 013
STATUS FOR FIVE EXISTING HEATING CIRCUIT PUMPS
EXISTING DDC PANEL
HYDRAULIC "BRIDGE" PIPING, SEE DETAL THIS SHEET
EXIST BOILER ROOM LOUVER, BLANK
SHWR
SHWS
EXISTING MECH ROOM
BACK PIPE HIGH AGAINST STRU
SHWS/R SUPPORTED ON NEW PIPE SUPPORTS (SEE STRU DWGS) - HEAT TRACE EXTERIOR PIPING TO PROTET AGAINST OAT DOWN TO -15°F
STS 014
1-1/4"
ET 01
DCW
TT 003
1-1/2"
REDUCE PRESSURE BACKFLOW DEVICE RPBD-1
SHWS
SHWR
UH 01
UH 02
1"
LVT 01
005
006
PT 002
ALM 007
STS 007
VFD.P6
TT 004
3"
CFT 01
ALM 008
STS 008
VFD.P7
3/4" TO ID. WITH 3/4" HOSE CONNECTION FOR SAMPLE COLLECTION
P 07
P 06
004
TT 008
2
002
P 04
P 05
STS 005
B 02
TT 009
STS 006
TT 007
STS 002
ALM 002
2-1/2"



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COMMON CONSTRUCTION MISTAKES

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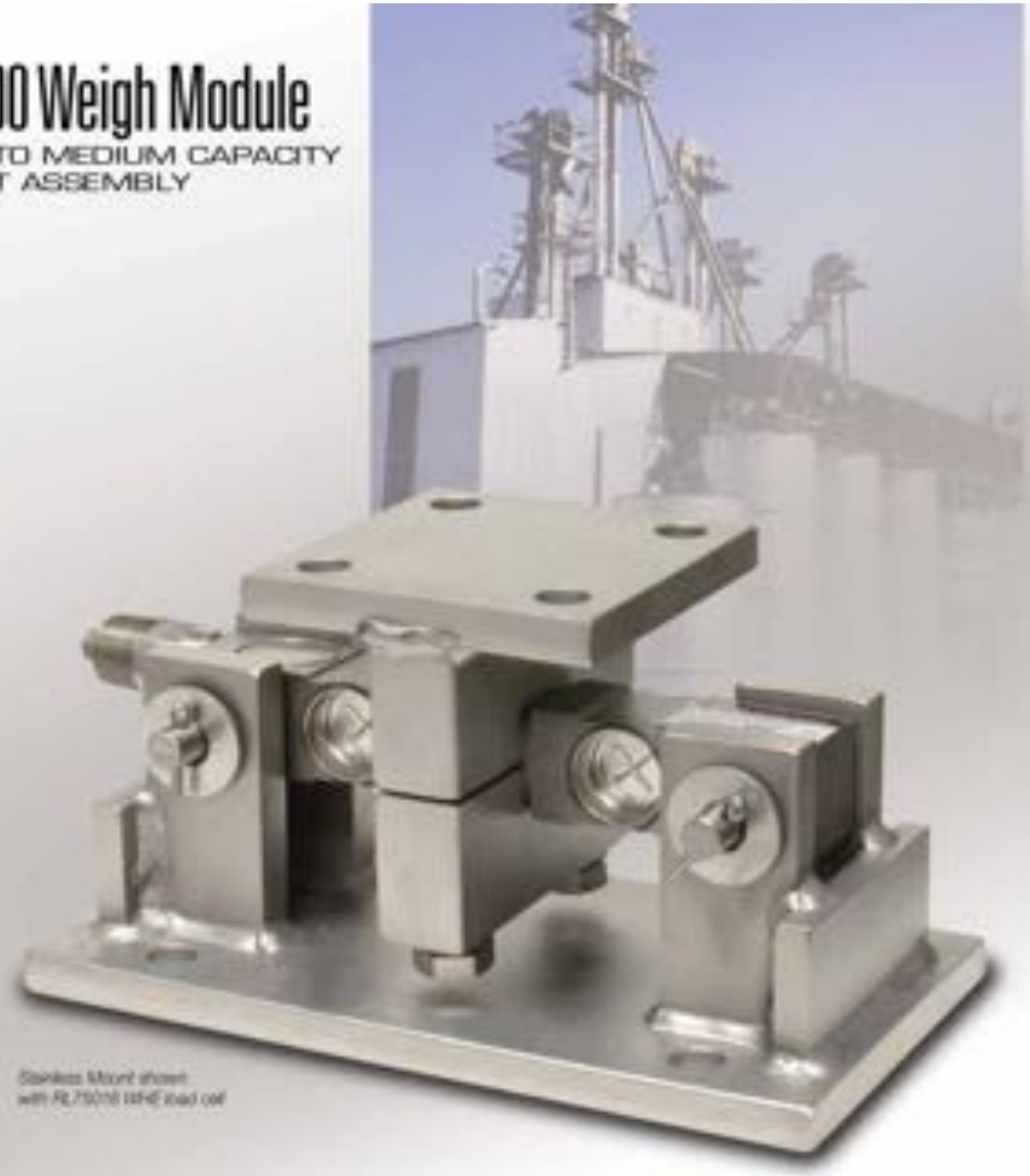
- Over budget
- Insufficient Construction Management
- Inadequate Commissioning
- Insufficient Operator Training

OVERBUDGET

- **Poor Cost Estimates**
  - Need detail costs estimates with full labor and material breakdown, generally 50-100 line items
- **Alaska Factor?**
  - Precedent to choose local vendors even if it's 4x more expensive or not as high quality
- **Solutions:**
  - Equipment Pre-Purchase when possible
  - Containerization

RL1600 Weigh Module

LIGHT TO MEDIUM CAPACITY
MOUNT ASSEMBLY



Stainless Mount shown
with RL75016 WHE load cell

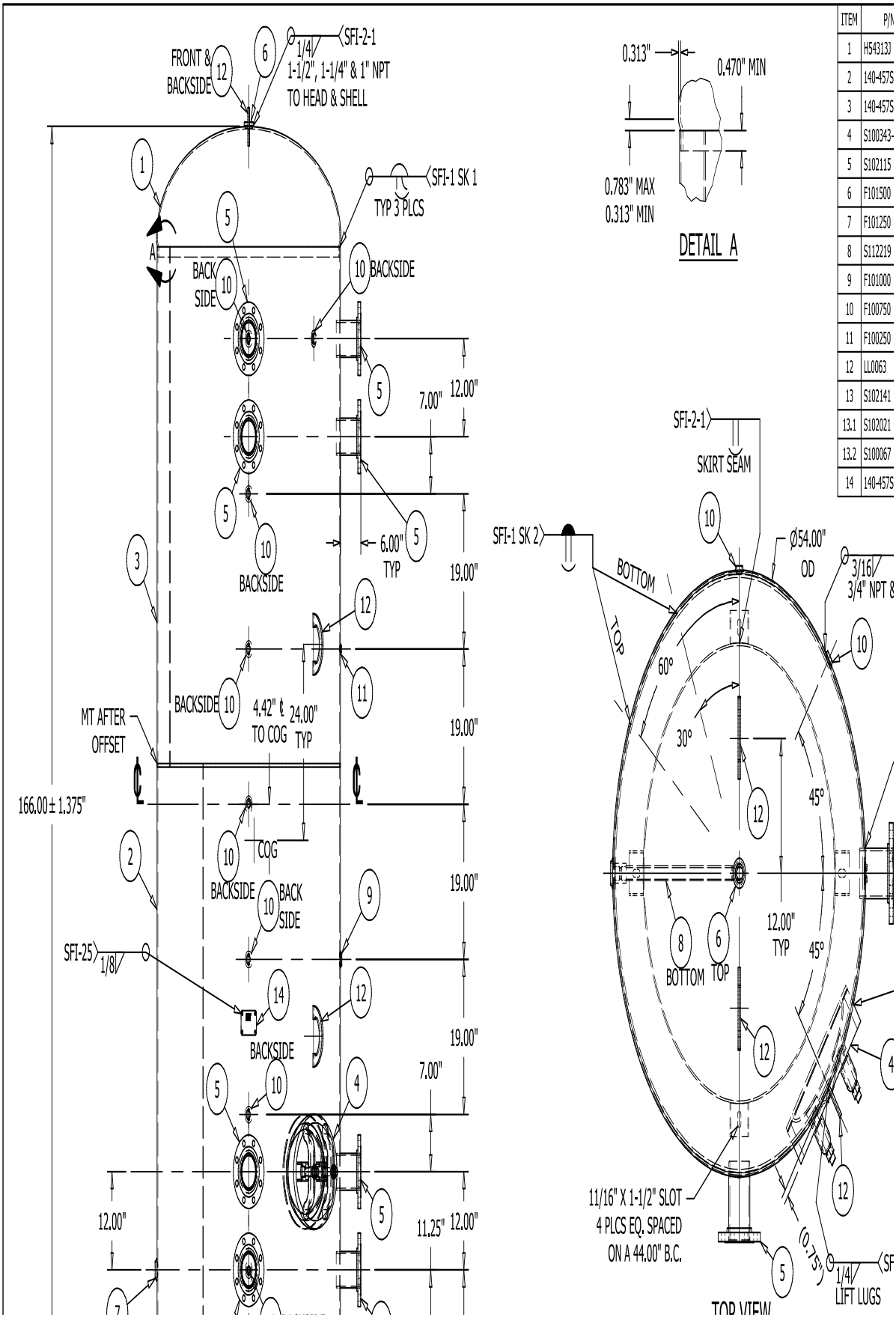
ALASKA FACTOR

- Specified product was $8,000 in lower 48
- Product was purchased in Alaska for $20,000
- Important to get competitive bids for specialty items
- Some extra costs for remoteness are justified, but need to evaluate on case-by-case basis

EQUIPMENT PRE PURCHASE

- **Large ticket items can be purchased direct by project Owner to help contain costs**
  - Items that can work well to purchase direct:
    - Boilers
    - Tanks
    - PEX piping
  - These are relatively simple, yet high cost items
  - Contractor markup is usually not justified in relation to risk
  - Pre-purchase of long lead items can shorten schedules

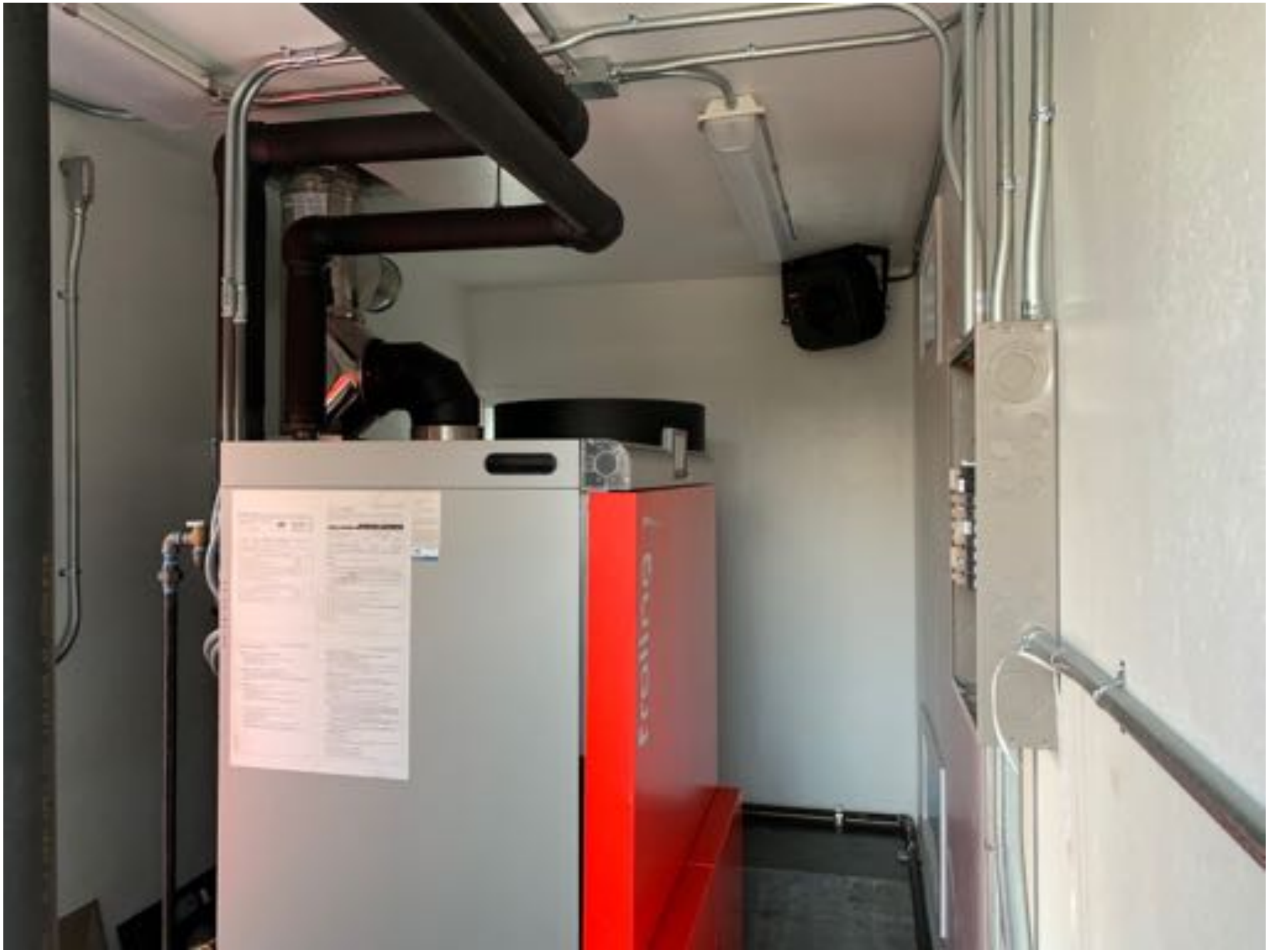

United Rentals



ITEM	P/N
1	H54313J
2	140-457S
3	140-457S
4	S100343-
5	S102115
6	F101500
7	F101250
8	S112219
9	F101000
10	F100750
11	F100250
12	LL0063
13	S102141
13.1	S102021
13.2	S100067
14	140-457S

CONTAINERIZATION

- **Containerizing boilers for cost containment in remote locations**
  - Site work generally suitable for local contractors
  - Complex mechanical work can take place in controlled environment
  - Containerized packages available from boiler vendors, limiting burden on local mech. firms with little experience with equipment
  - Allow MEP work to proceed in parallel with Site Work
  - Pre-purchase of container systems can allow lower overall project cost



MANAGEMENT AND TRAINING

- **Insufficient Construction Management**
  - Need on-site assistance for complex systems that local contractors are not familiar with
  - Typically should have site visits by Engineering firms at the kick-off of each new craft/discipline
- **Commissioning and Training**
  - Need multiple days/weeks at start-up
  - Need follow up in Fall of first heating system to work out kinks


KOB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WE
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Community and Environment
ANDREW HADEN, PRESIDENT
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