

# **WATER & WASTEWATER: Challenges and Treatment Options**

College Station, Texas  
(August 5-6, 2014)



## ***ARCTIC RECIRC SKID<sup>®</sup>*** ***Design/Build Challenges***

Global Petroleum Research Institute (GPRI)  
Texas Engineering Experiment Station (TEES)  
The Texas A&M University System (TAMU)



Presented by  
William O. Irvine, MBA, P.E.  
Engineering Fluid Solutions



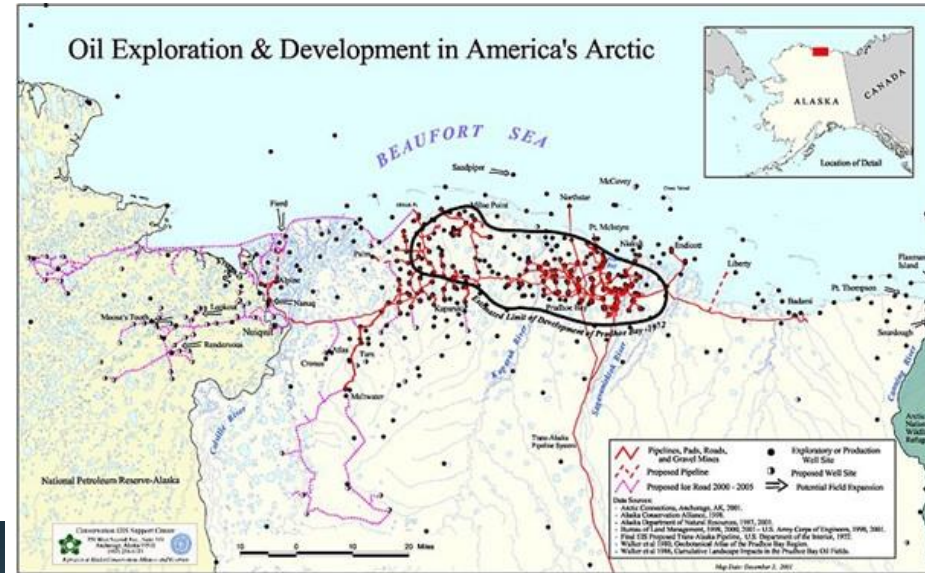
# Prudhoe Bay, Alaska



# Background

## PRUDHOE BAY, AK (British Petroleum Exploration Alaska)

- High winds (109 mph)
- Extreme cold (-62° F)
- Remote location (arctic)
- Transportation (high labor costs)



# Problem & Solution

## PROBLEM:

Excessively high maintenance and transportation costs associated with single-use of well clean-out water



Trailer-mounted dead-end filter pods



Single-use fluids truck transport

## SOLUTION:

Provide complete packaged fully automatic water filtration system allowing recirculatory reuse of well clean-out water



# General Design Parameters

- ◀ Arctic duty
- ◀ Ruggedized
- ◀ Heavy duty / robust
- ◀ Operability
  - ◀ High winds
  - ◀ Extreme cold
  - ◀ Blizzard conditions
- ◀ Complete packaged
- ◀ Removable equipment
- ◀ Maintainable & accessible
- ◀ Integrable & stand alone functionality
- ◀ Fully automated self cleaning
- ◀ Mobile / portable



# Reconnaissance Trip

## ◀ Prudhoe Bay / Deadhorse (North Slope)

- ◀ Largest oilfield in North America
- ◀ Located on coast of Arctic Ocean
- ◀ Satellite oilfields (Kuparuk, Endicott, Point MacIntyre, Milne Point, and Niakuk)

## ◀ Production

## ◀ Permafrost

## ◀ Continuous 24-hr operation

## ◀ Safety regulations

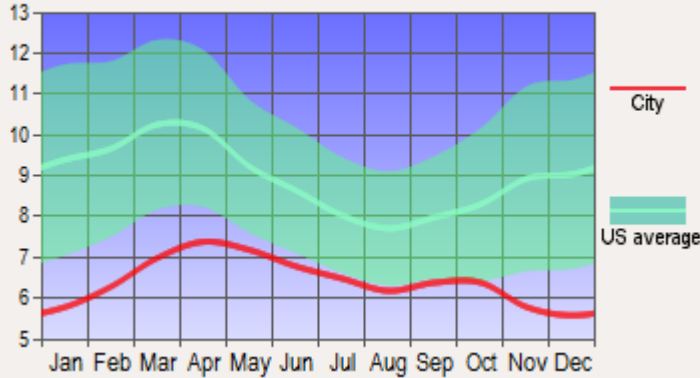
- ◀ Clothing
- ◀ Buddy system
- ◀ Weather classification
- ◀ Operation cut-off temperature (-40° F)

## ◀ Integrated trailer transport or hauler truck



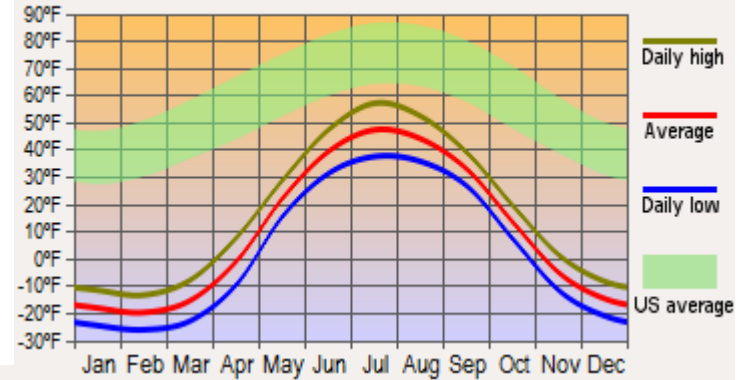
# Prudhoe Bay Weather

## Wind Speed (mph)



Highest wind speed 109 mph

## Average Temperatures

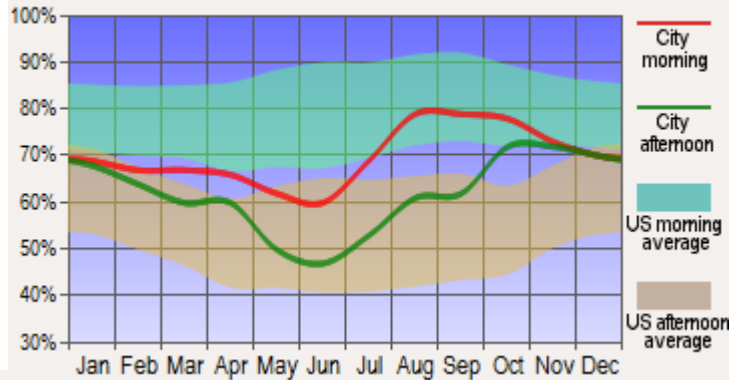


Lowest recorded temperature -62°F

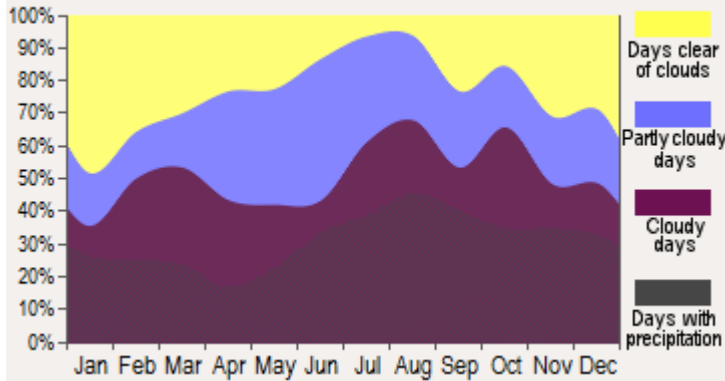
Lowest wind chill -102°F  
(-54°F @ 36 mph wind)

Mean annual temperature -12°F

## Humidity



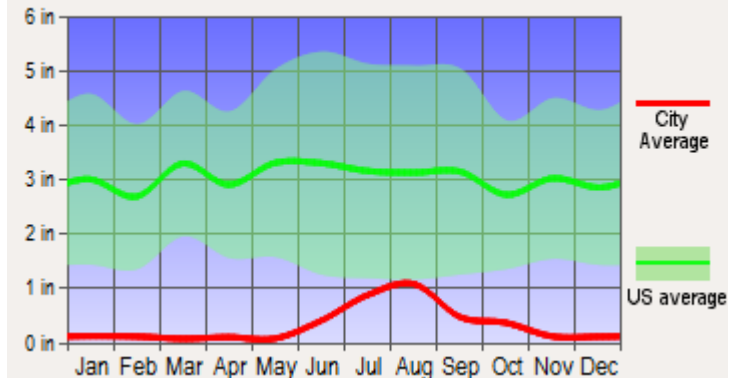
## Cloudy Days



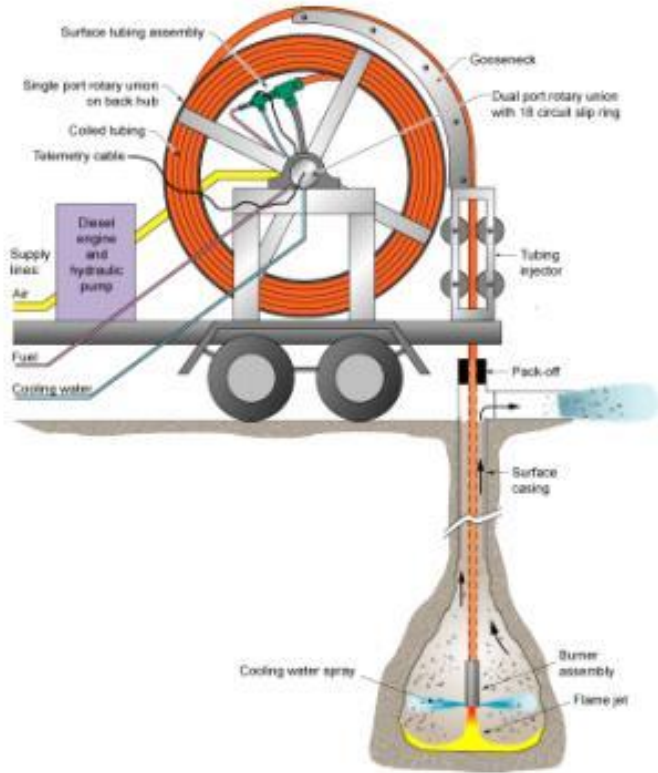
Longest day is 64 days

Shortest day 45 minutes

## Precipitation



# Coiled Tubing Operations

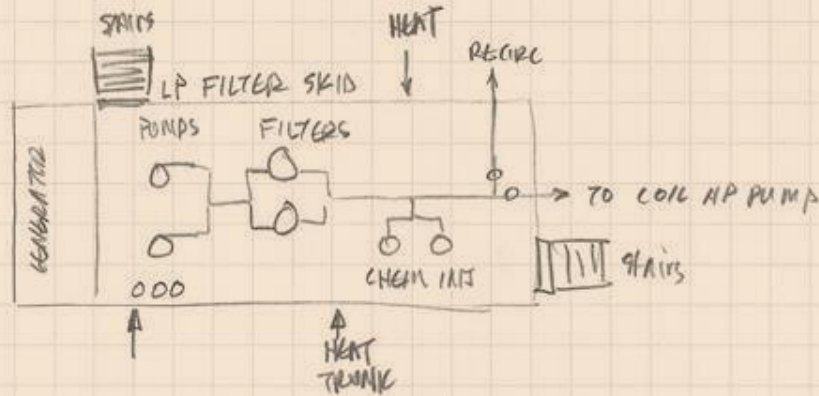
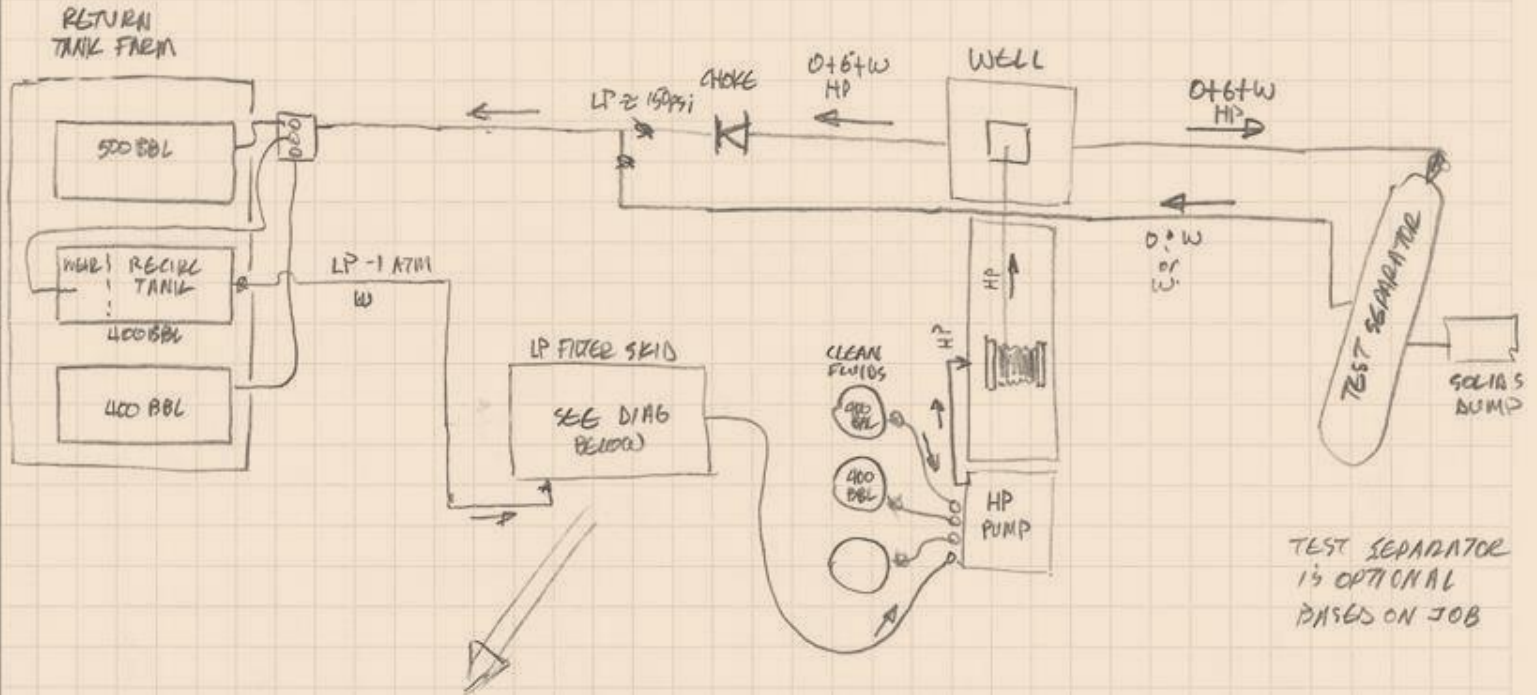




# Rough Well Plan Sketch

Calculations Chart

Sheet number of Date 3-DEC-08 By ICF



# Well Cleanout Fluids Management

## Single-use fluids transport

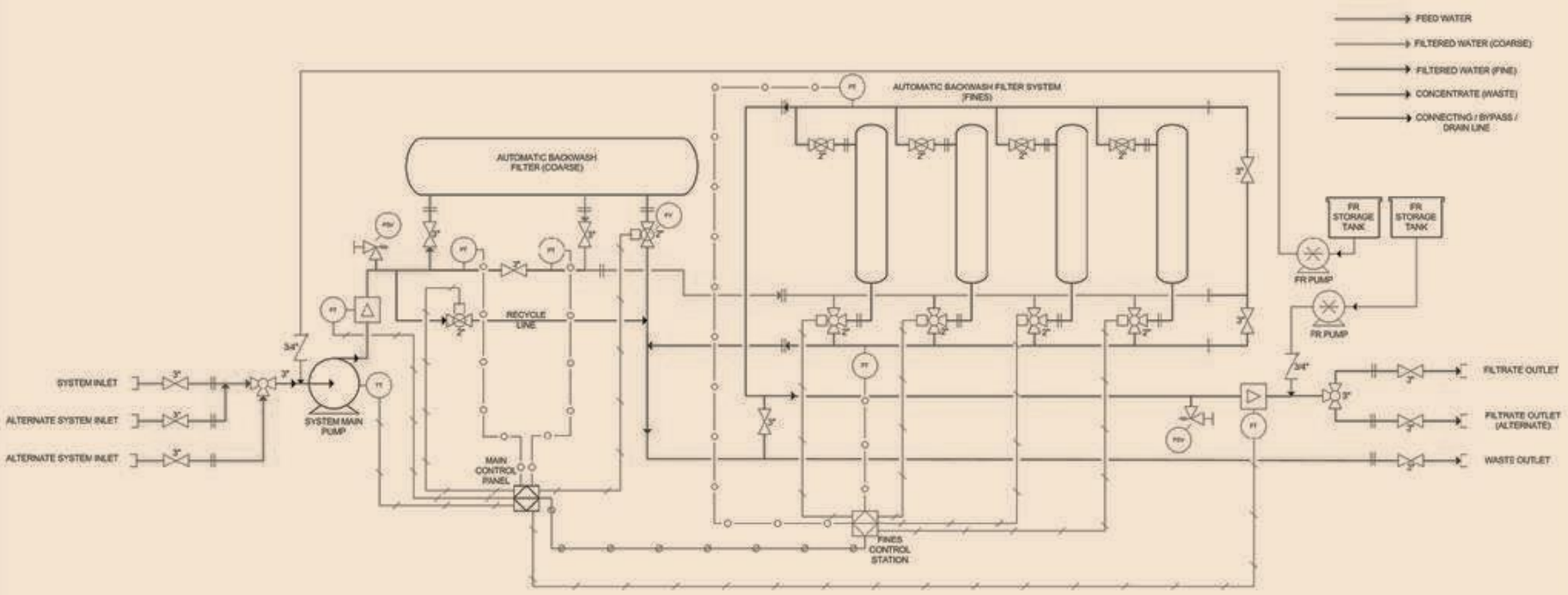


## Trailer-mounted filter pods



# Stand Alone Process Flow Diagram

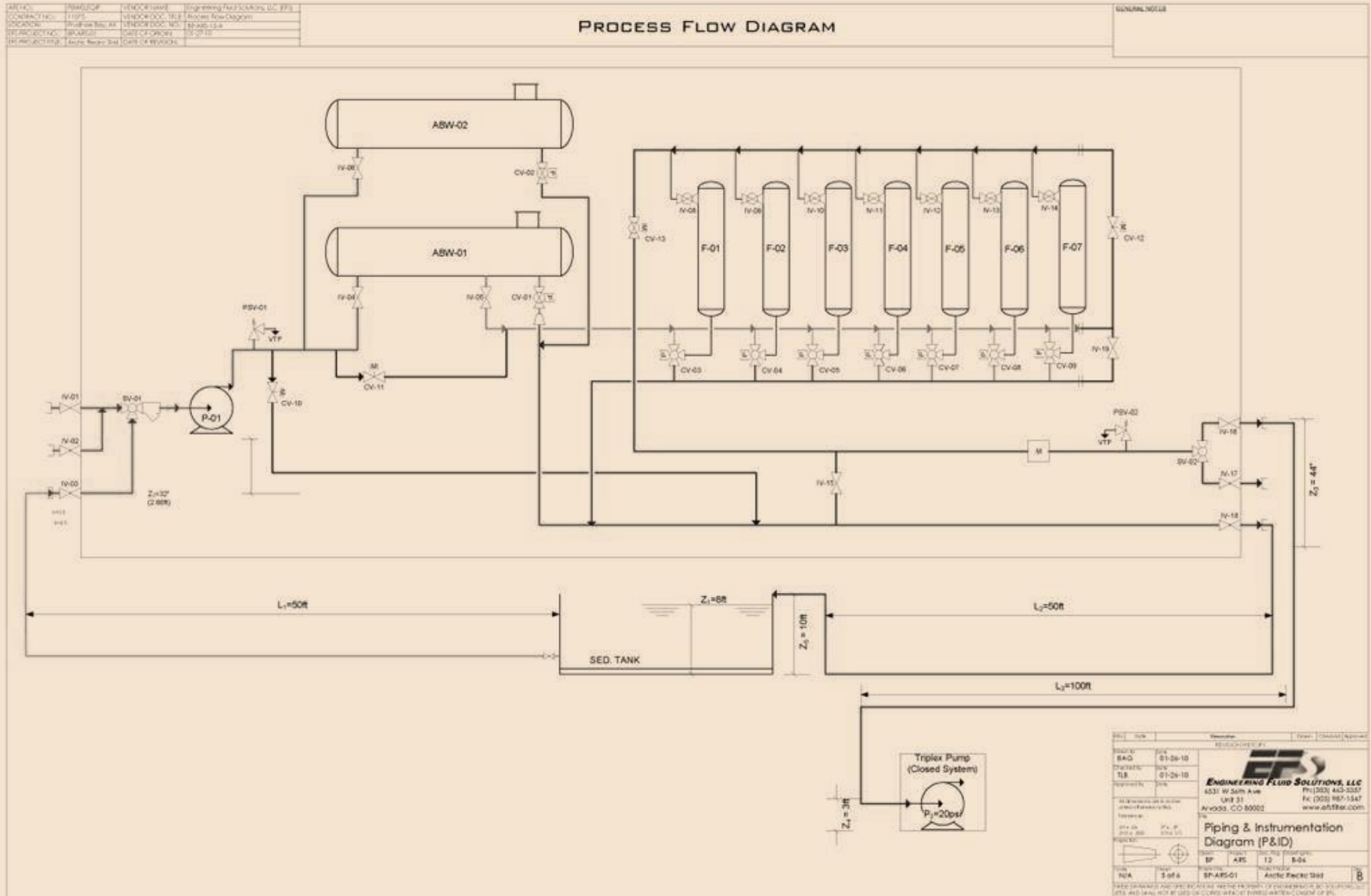
REVISION: 0      DESCRIPTION: 10/6/2009



<p>THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF ENGINEERING FLUID SOLUTIONS, LLC(EFS) AND SHALL NOT BE USED OR COPIED WITHOUT EXPRESS WRITTEN CONSENT BY EFS</p>	PROJECT:	BP-ARS	TITLE:	Arctic Rectic Skid Preliminary Process Flow Diagram	TOLERANCE:	N/A
	CUSTOMER:	BPXA Anchorage, AK	DRAWN BY:	BAG	SCALE:	N/A
	JOB NO.:		CHECKED BY:		SHEET:	1 OF 1
			APPROVED BY:		DRAWING NO.:	N/A
			DATE:	10/6/2009		



# Integrated Process Flow Diagram



NO.	DATE	REVISION	BY	CHKD	APP'D
1	01-29-10	REVISED			
2	01-29-10	REVISED			
3	01-29-10	REVISED			

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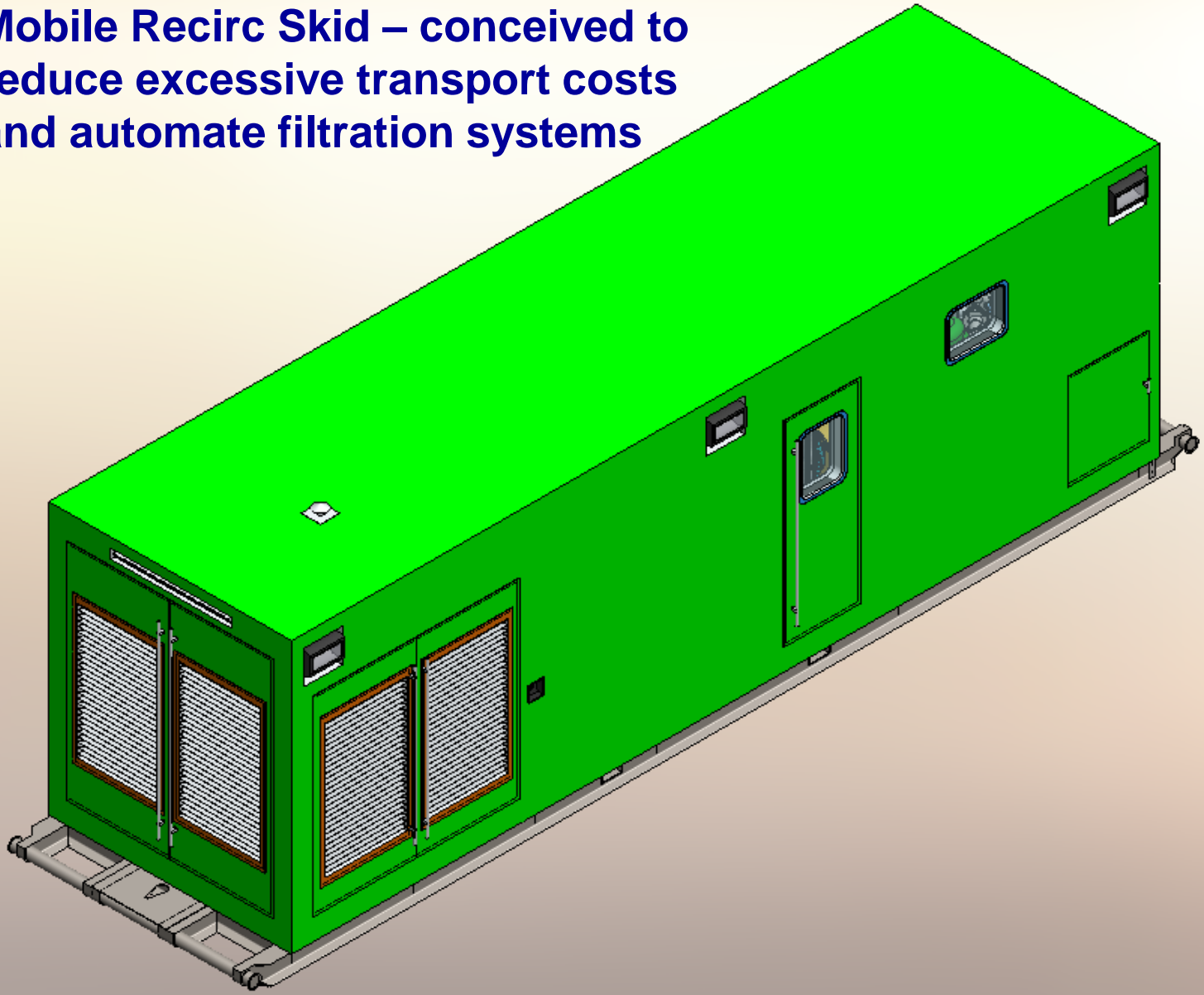
**Piping & Instrumentation Diagram (P&ID)**

PROJECT:	SPARCUSP	DATE:	01-29-10
CLIENT:	ARC	SCALE:	AS SHOWN
DESIGNER:	EP	NO. OF SHEETS:	12
CHECKER:	ARC	SHEET NO.:	8-04
APPROVED:	SPARCUSP	PROJECT:	ARCUS
SCALE:	AS SHOWN	DATE:	01-29-10

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# Enclosure Iso View

Mobile Recirc Skid – conceived to reduce excessive transport costs and automate filtration systems



# Specific Design Parameters

- ◌ -50°F storage / -40°F operating cutoff
- ◌ Extreme cold weather rating for XXHW-2 wire and electricals
- ◌ 110% hydraulic containment including 200-gal diesel suntank
- ◌ Adjustable flowrate from 0 bpm up to 5 bpm maximum flow
- ◌ Constant flow or constant pressure output
- ◌ Particle filtration down to 5 micron removal
- ◌ FR dosing rate based on dose pump speed or % of process flow
- ◌ Gel sweeps and laboratory testing



# Main System Components

- ◌ Arctic enclosure
- ◌ Space heaters
- ◌ Electric switchgear
- ◌ Ground reels
- ◌ Interior and exterior lighting w/emergency backup (LED & HPS)
- ◌ Controls – master controller w/vibration mitigation
- ◌ Pumps
- ◌ Electric drive motors w/low temp grease
- ◌ Dosing system
  - ◌ Variable frequency drives
- ◌ Piping
- ◌ Instruments
- ◌ Valves / automatic actuation
- ◌ Air compressor and dryer
- ◌ Generator w/subtank or shore power



# Features

## TEMPERATURE

- ◌ Arctic duty (-40° F operation, -50° F storage)
- ◌ Temperature control via louver modulation and temp switch
- ◌ Start / stop thermostatic temperature control
- ◌ Condensate management

## ELECTRICAL

- ◌ Self powered generator or shore power
- ◌ Interior and exterior e-stops
- ◌ Phase monitor light
- ◌ Interior and exterior convenience receptacles





# Features



## PROCESS

- ◌ Inlet and outlet hydraulic hook-up connections on both sides
- ◌ Manual and automatic hydraulic by-pass
- ◌ User adjustable output pressure and flowrate
- ◌ 2-stage filtration system (25 / 5 micron)
- ◌ Single use to multiple use
- ◌ PLC-driven controls (centralized controls)
- ◌ Auto-backwashing filters
- ◌ Overpressure protection
- ◌ Flowrate and pressure control
- ◌ Friction reducer dosing system
- ◌ Portability (skidded tail roll)
- ◌ Blow out ports and drains

# Features

## ARCHITECTURAL

- ◀ Skidded / mobile
- ◀ Tail roll design
- ◀ Easily transported on hauler truck or integrated trailer
- ◀ Vibration mitigation
- ◀ Fully-packaged
- ◀ Automated
- ◀ Stand alone
- ◀ Removable equipment within for maintenance



Ease of mobility

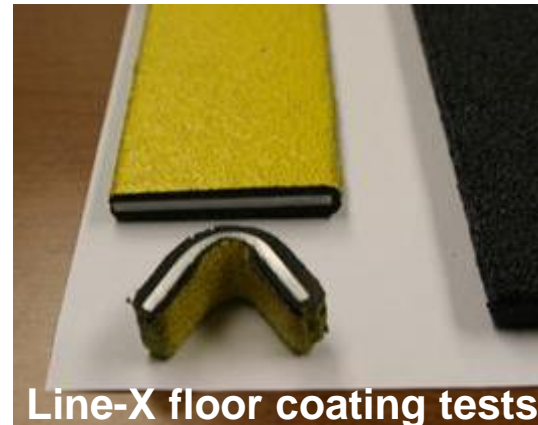


Tail roll design

# Features

## ARCHITECTURAL

- ☛ Maintainable & accessible equipment
- ☛ Fire-rated dividing wall construction compartmentalizes filter room from generator room
- ☛ R35 wall insulation
- ☛ Nonskid floor coating
- ☛ Freezer door hardware
- ☛ Double-pane thermal windows w/thermal breaks

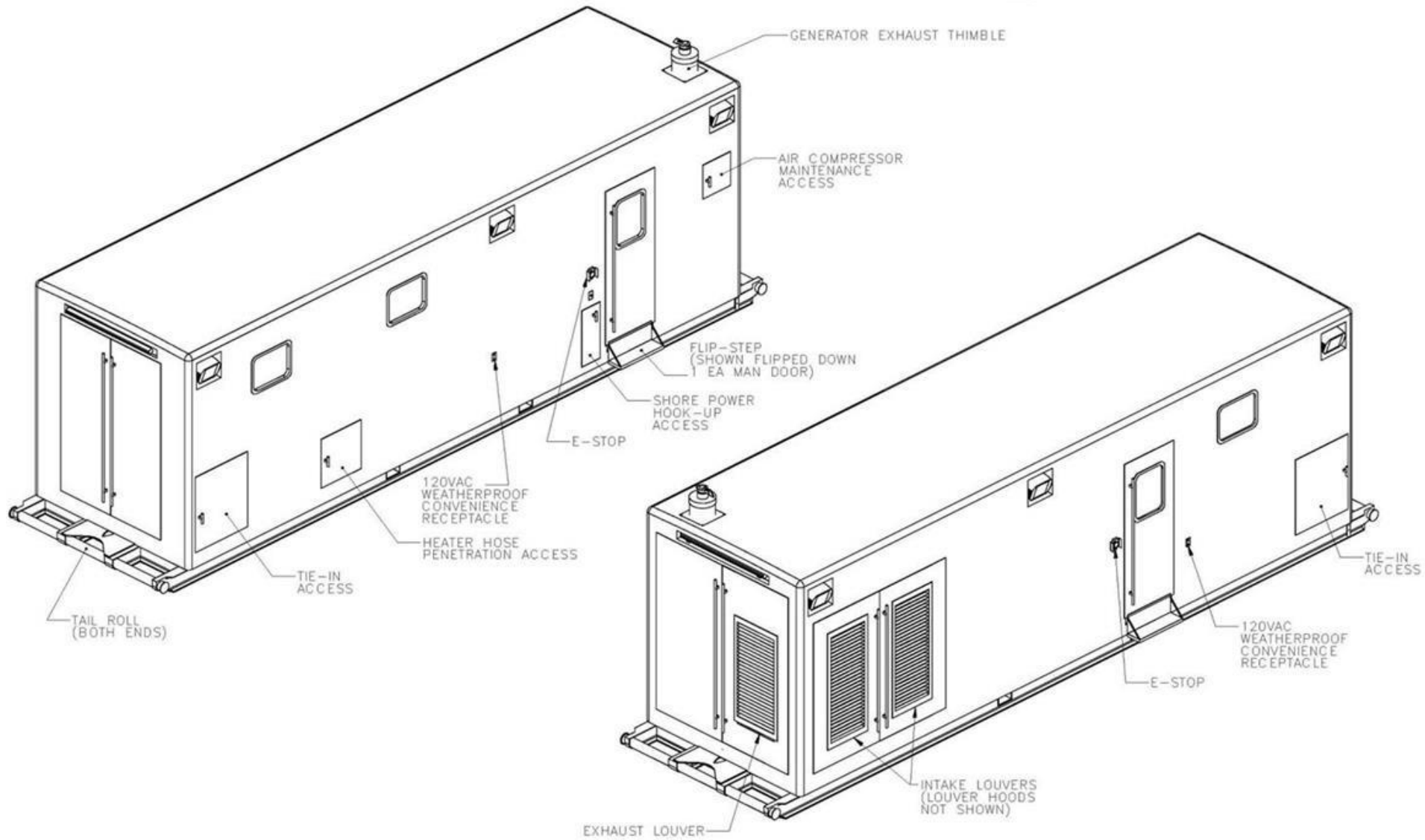


# ARS® Recirc Skid Is/Does:

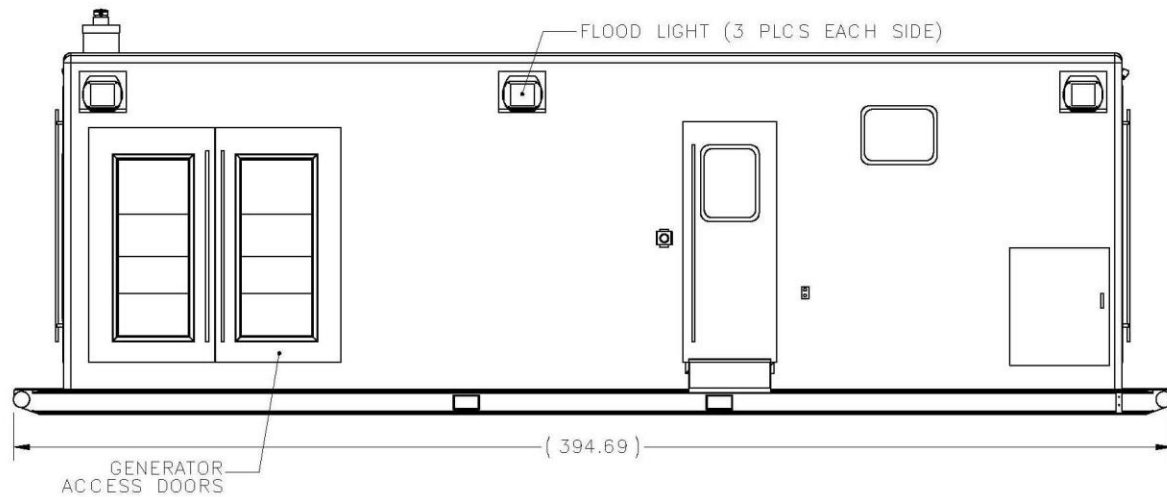
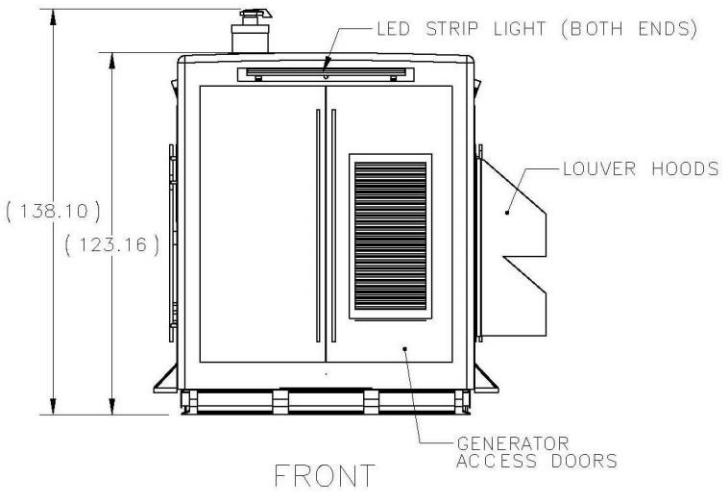
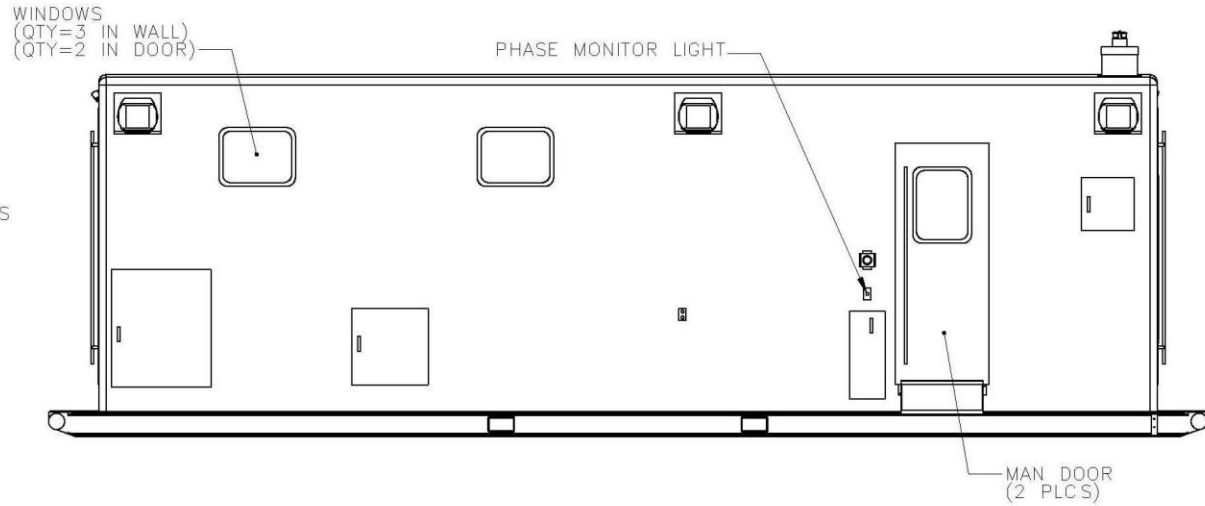
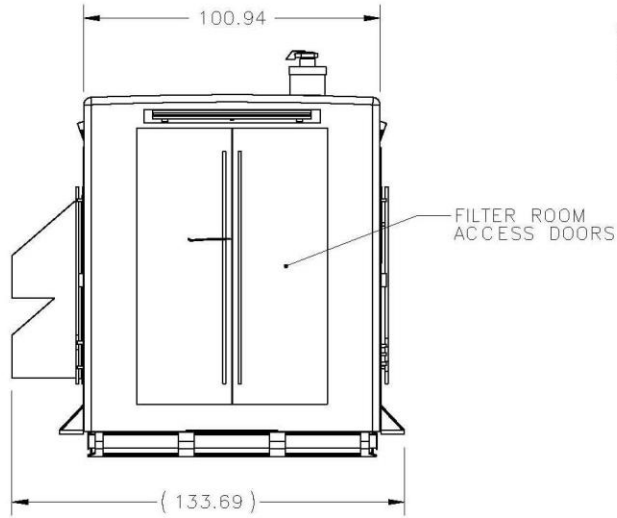
- ☛ Fully-packaged, fully-automated, stand-alone **filtration system** for oilfield services and produced water management
- ☛ Developed primarily for **coiled tubing operations** to reduce excessive use of water in oil and gas well cleanouts
- ☛ Allows reuse of on-site produced water, reducing the amount of fresh water needed for produced water applications and hazards associated with **transport and disposal** of water
- ☛ Coiled tubing fluids are returned downhole, saving on otherwise **single-use drilling fluids**
- ☛ Promotes efficiency in fluids management of **friction reducers** and produced water
- ☛ 2-stage filtration system **filters particulate down to 5 µm** when used in conjunction with a settling basin or tank farm
- ☛ Continuously and **automatically self-cleans** internal filter elements and returns backwash water to tank farm
- ☛ **Fully customizable, scalable**, and can be designed to meet specific application requirements



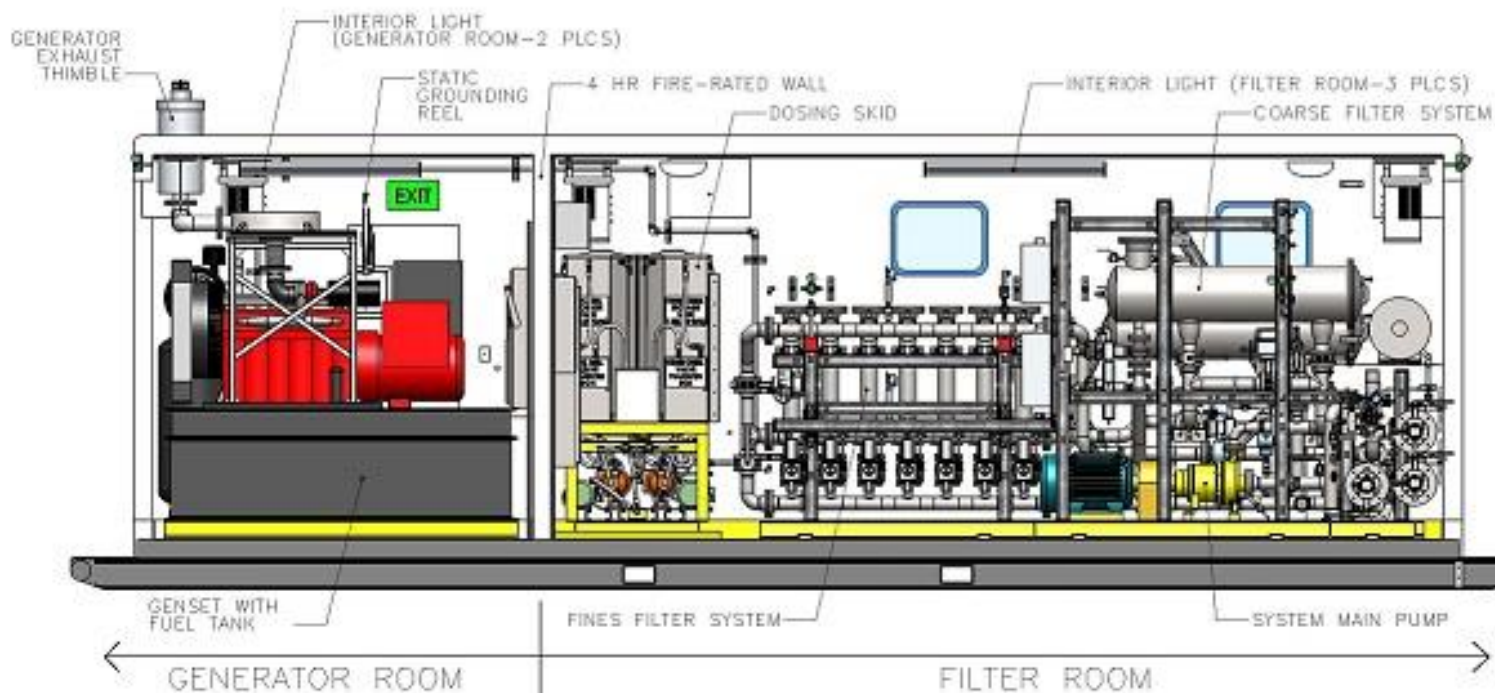
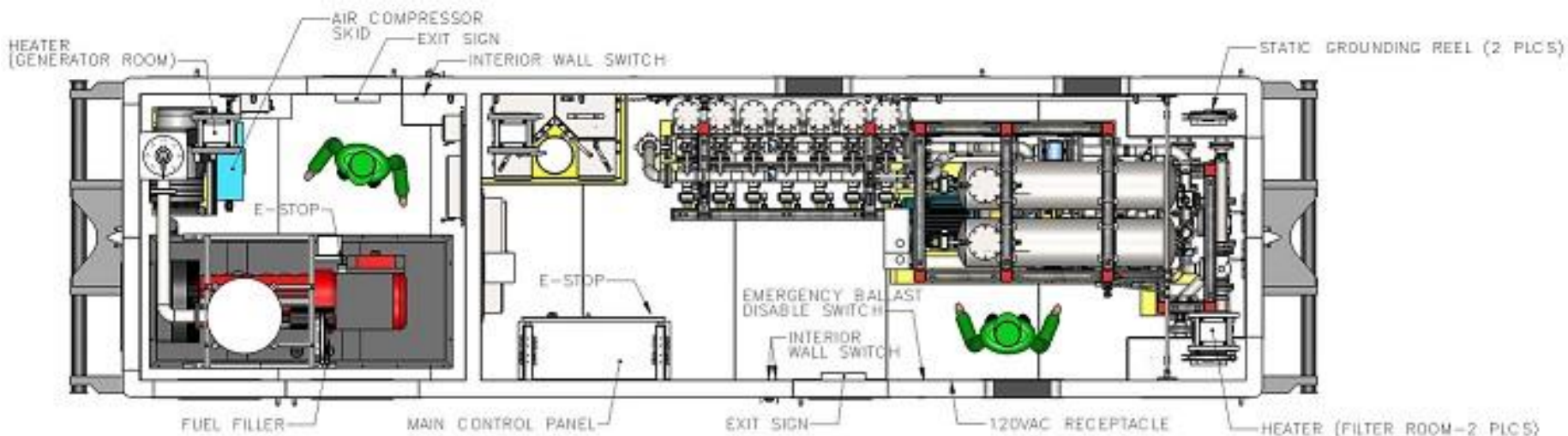
# General Arrangement



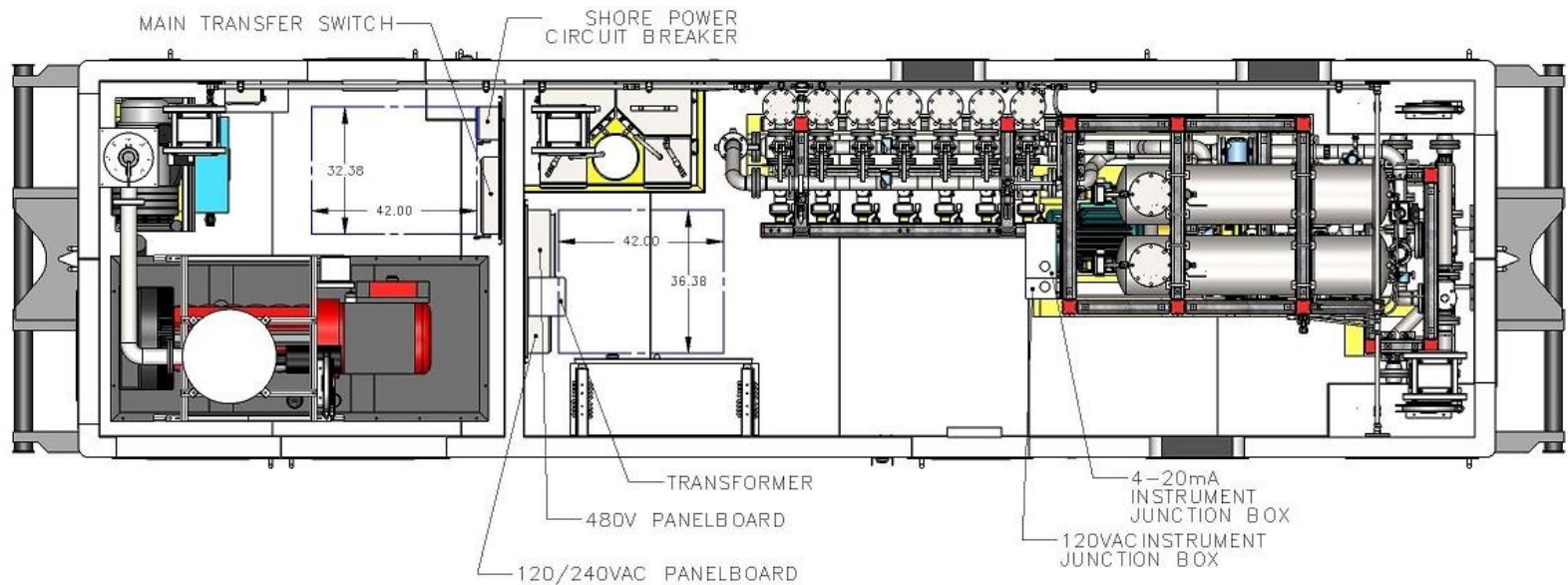
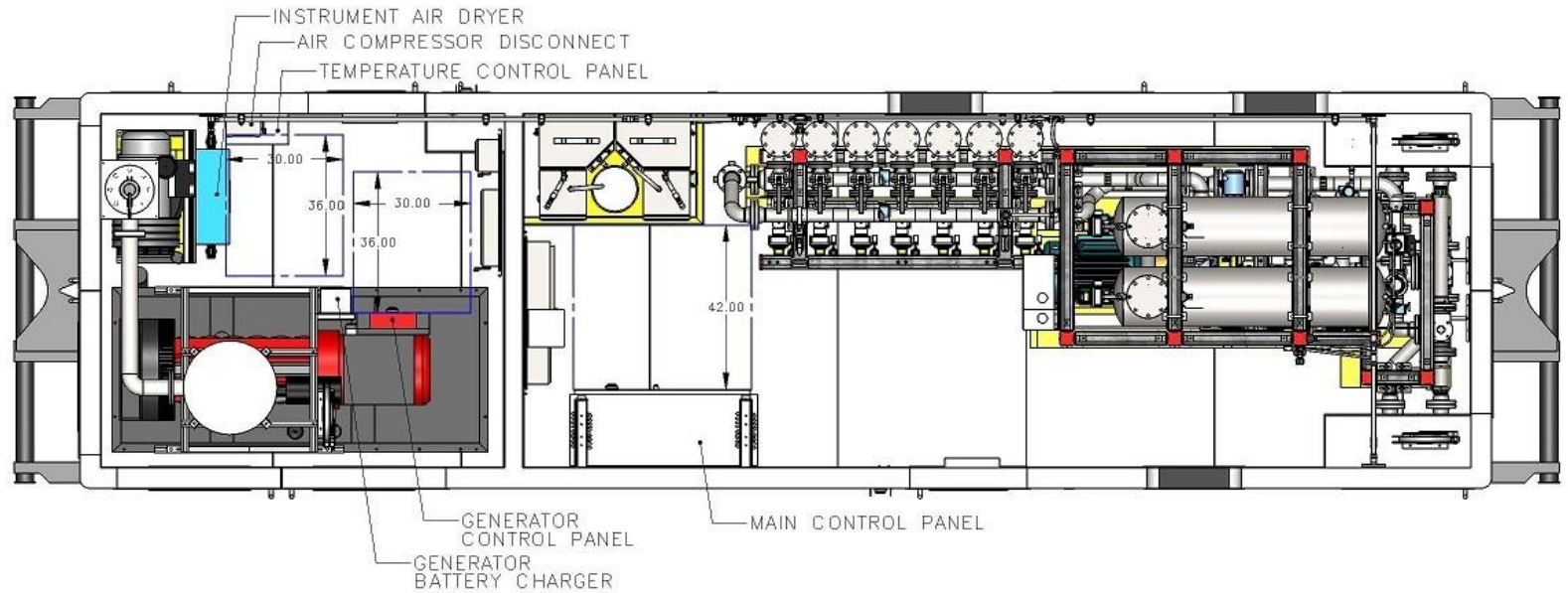
# Elevation Views



# Section Views

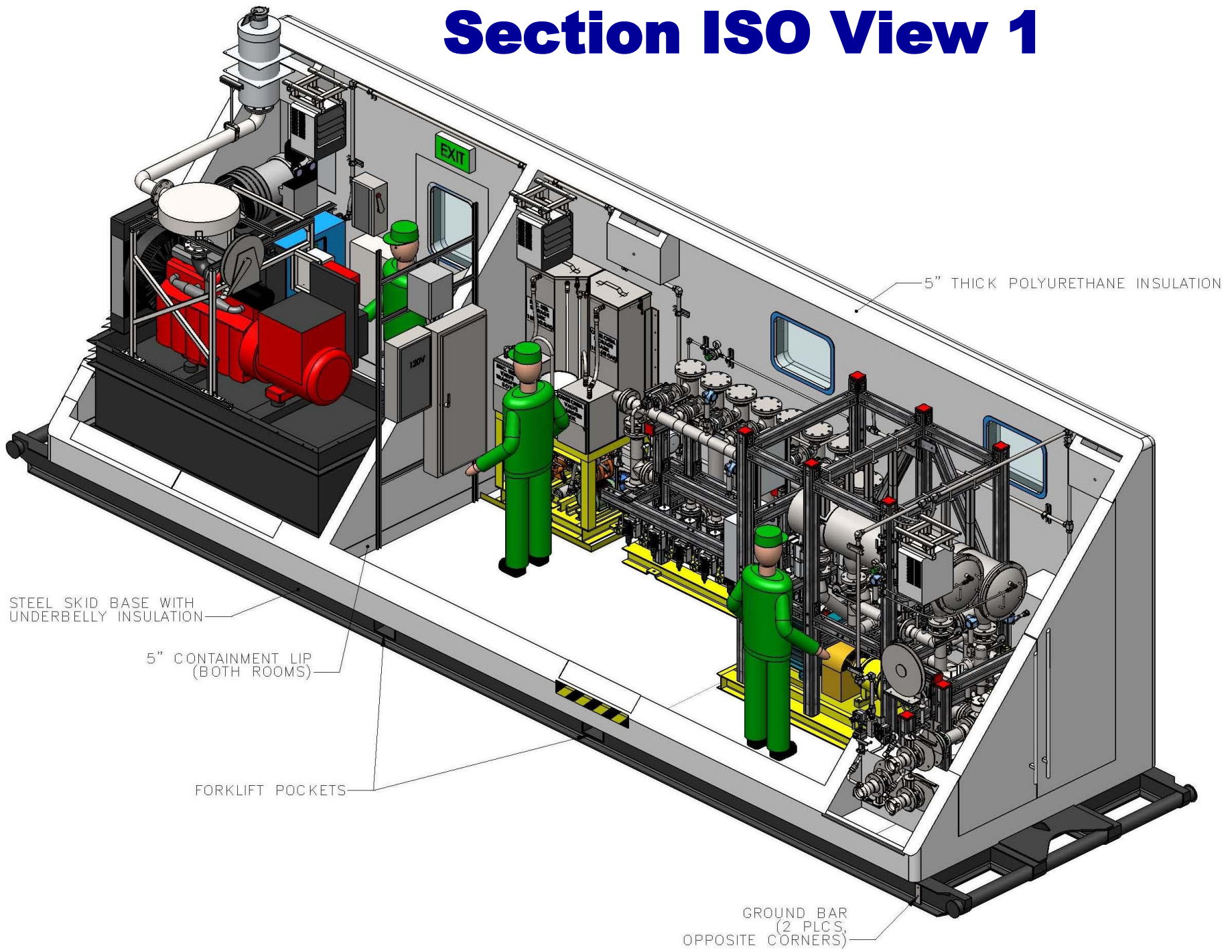


# Section Plan Views





# Section ISO View 1



5" THICK POLYURETHANE INSULATION

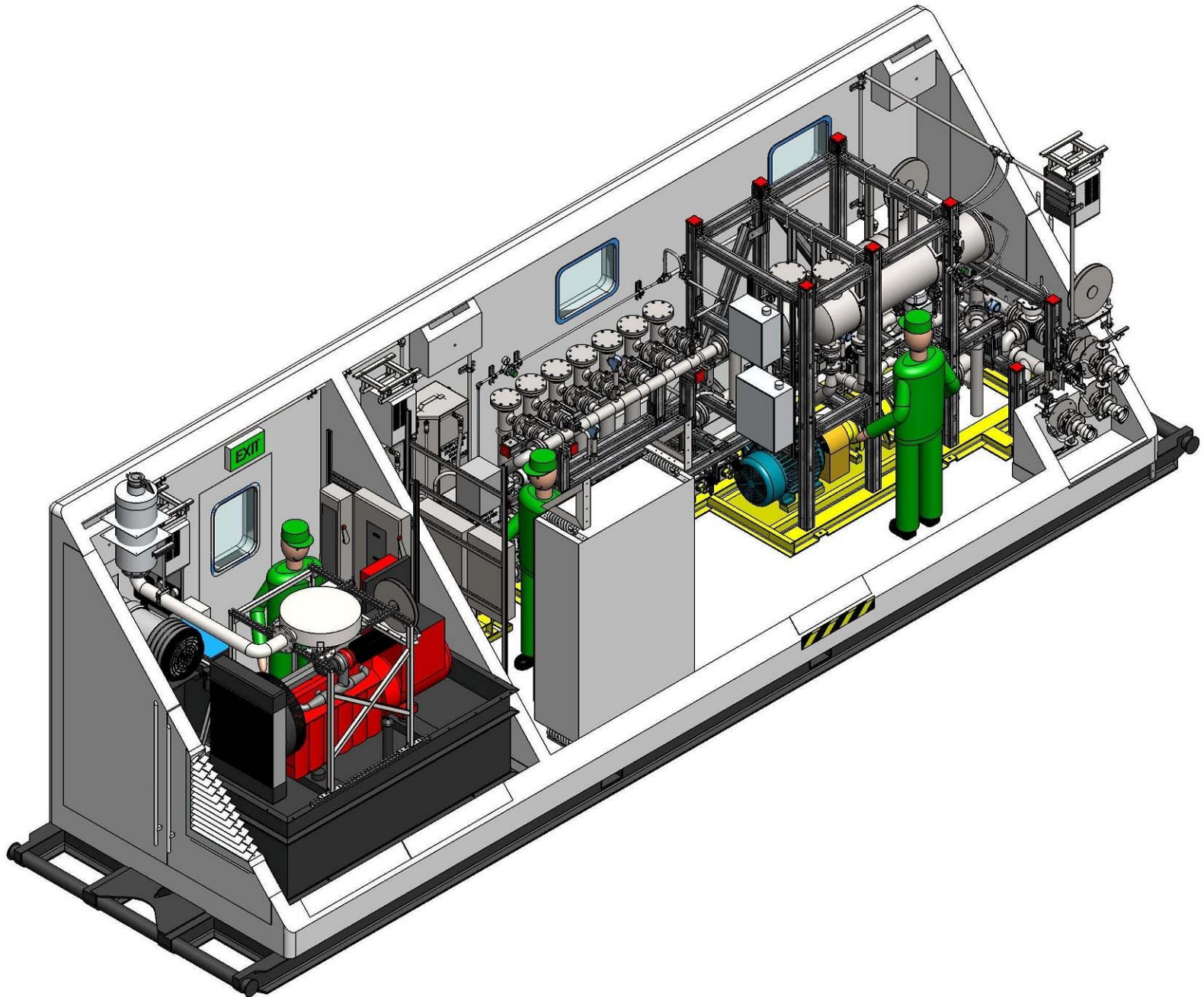
STEEL SKID BASE WITH UNDERBELLY INSULATION

5" CONTAINMENT LIP (BOTH ROOMS)

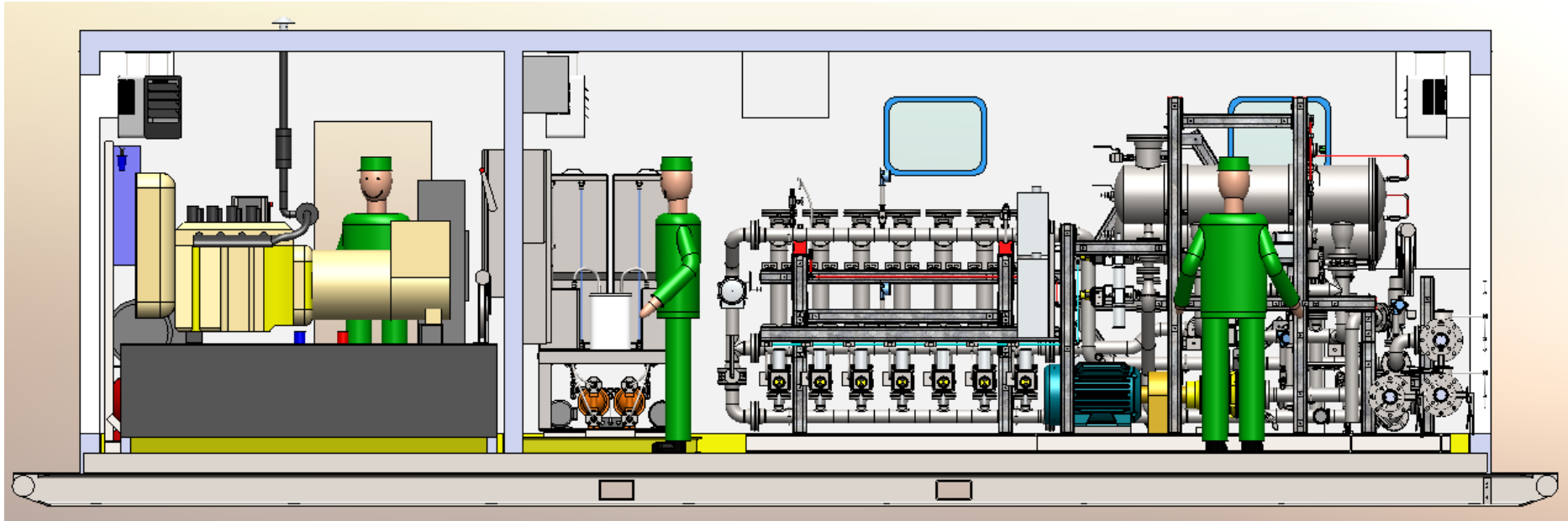
FORKLIFT POCKETS

GROUND BAR (2 PLC'S, OPPOSITE CORNERS)

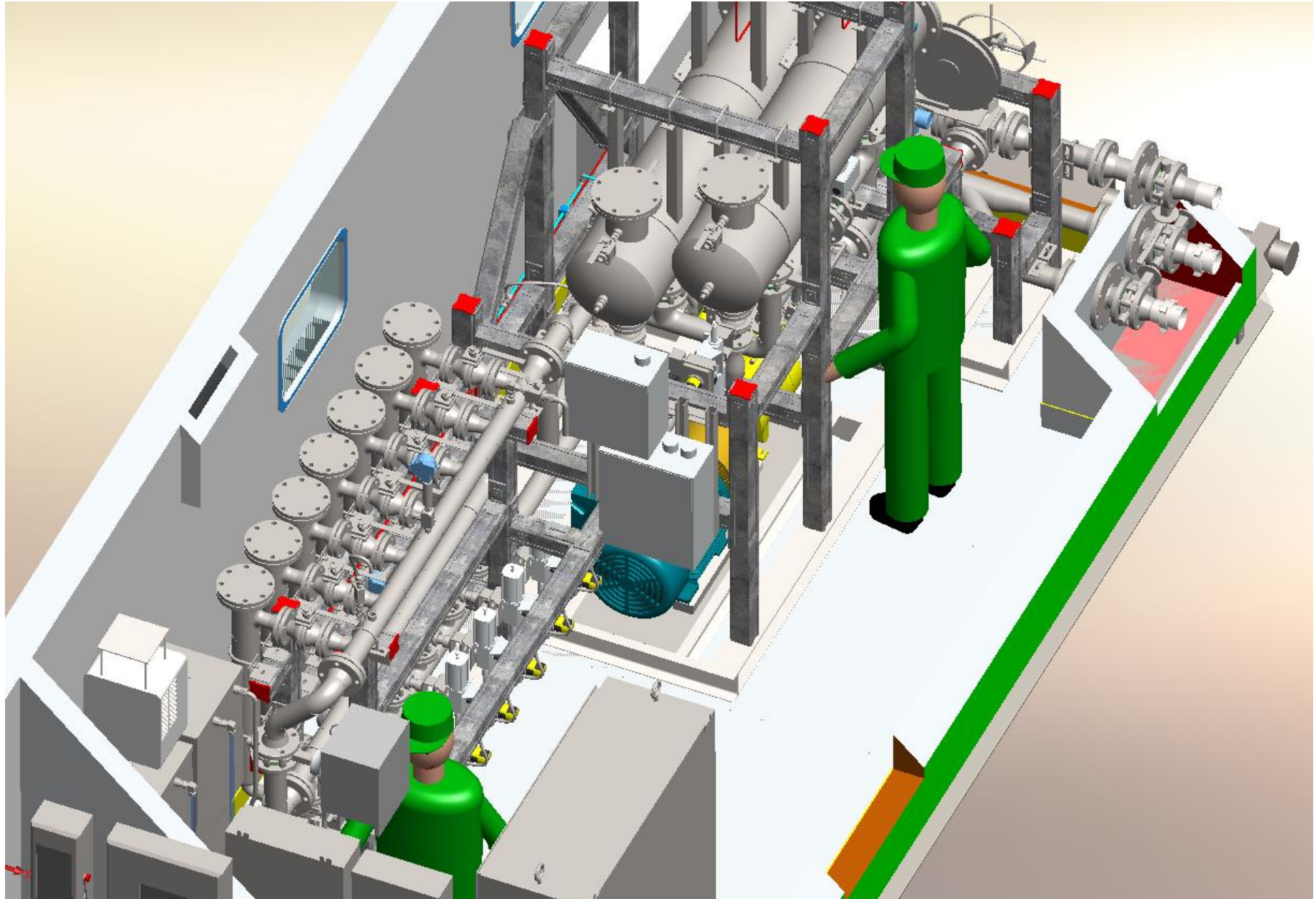
# Section ISO View 2



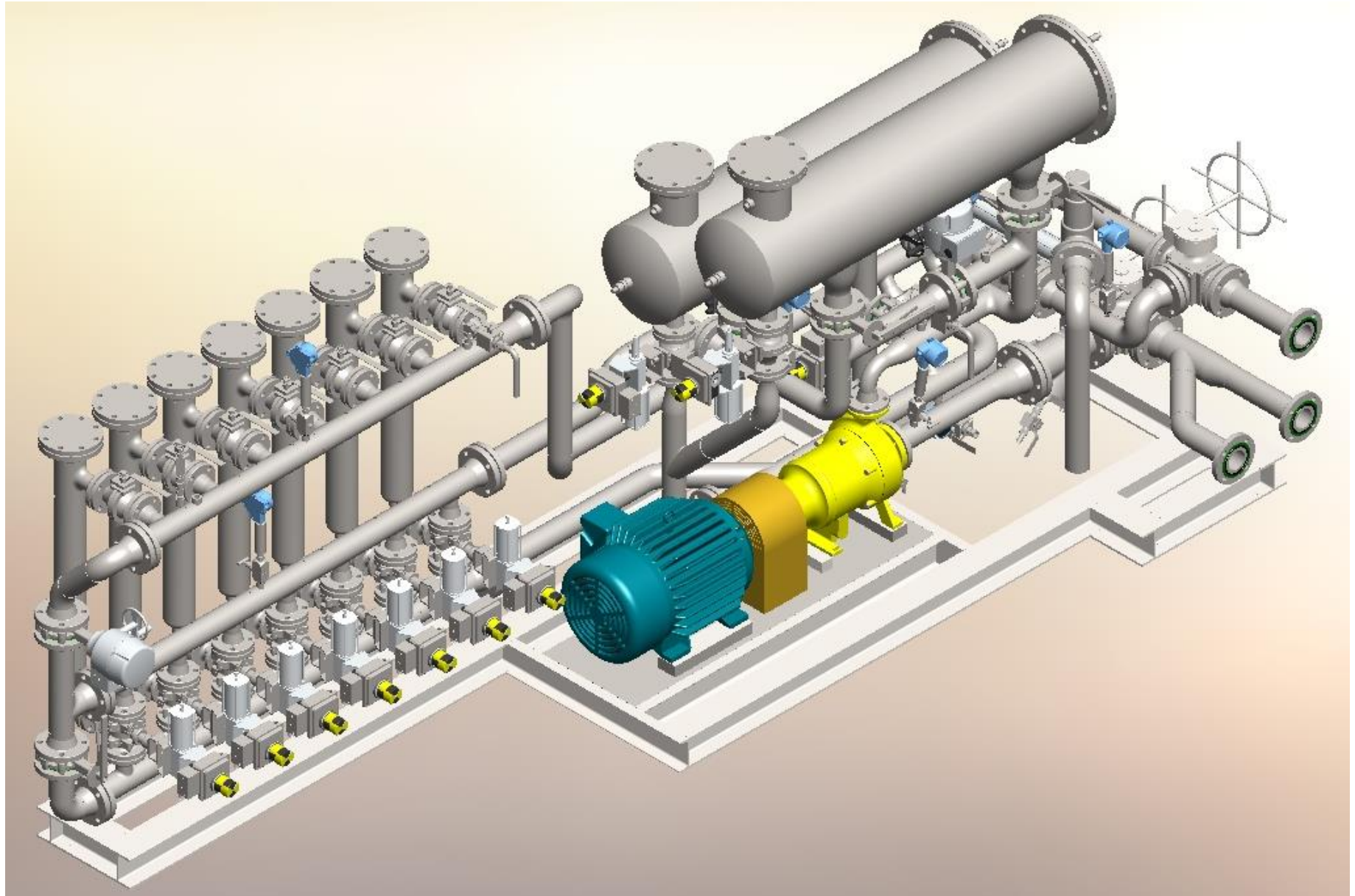
# Elevation Section



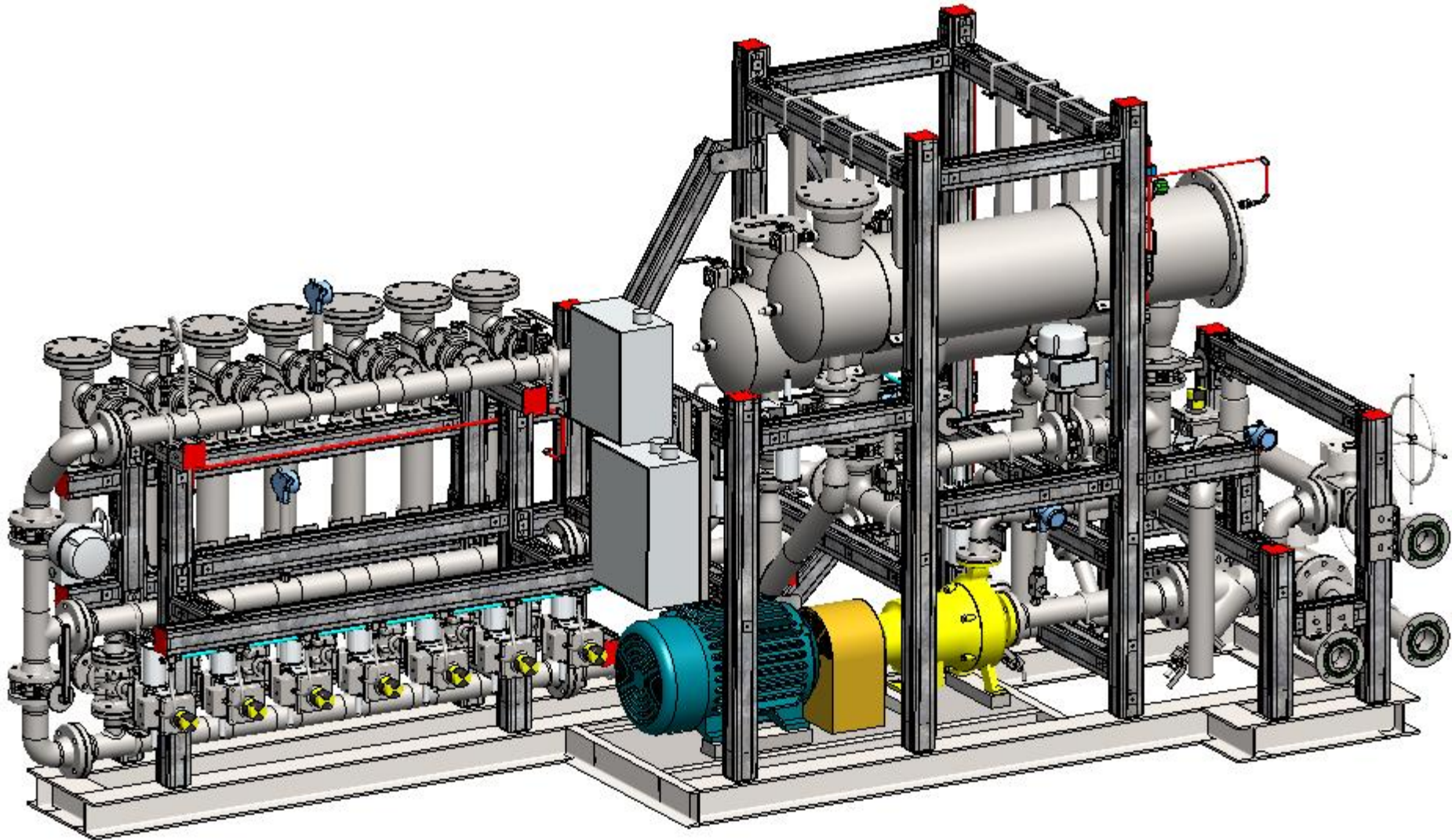
# Top ISO View



# Pump Piping & Filters



# Filter Skid Design



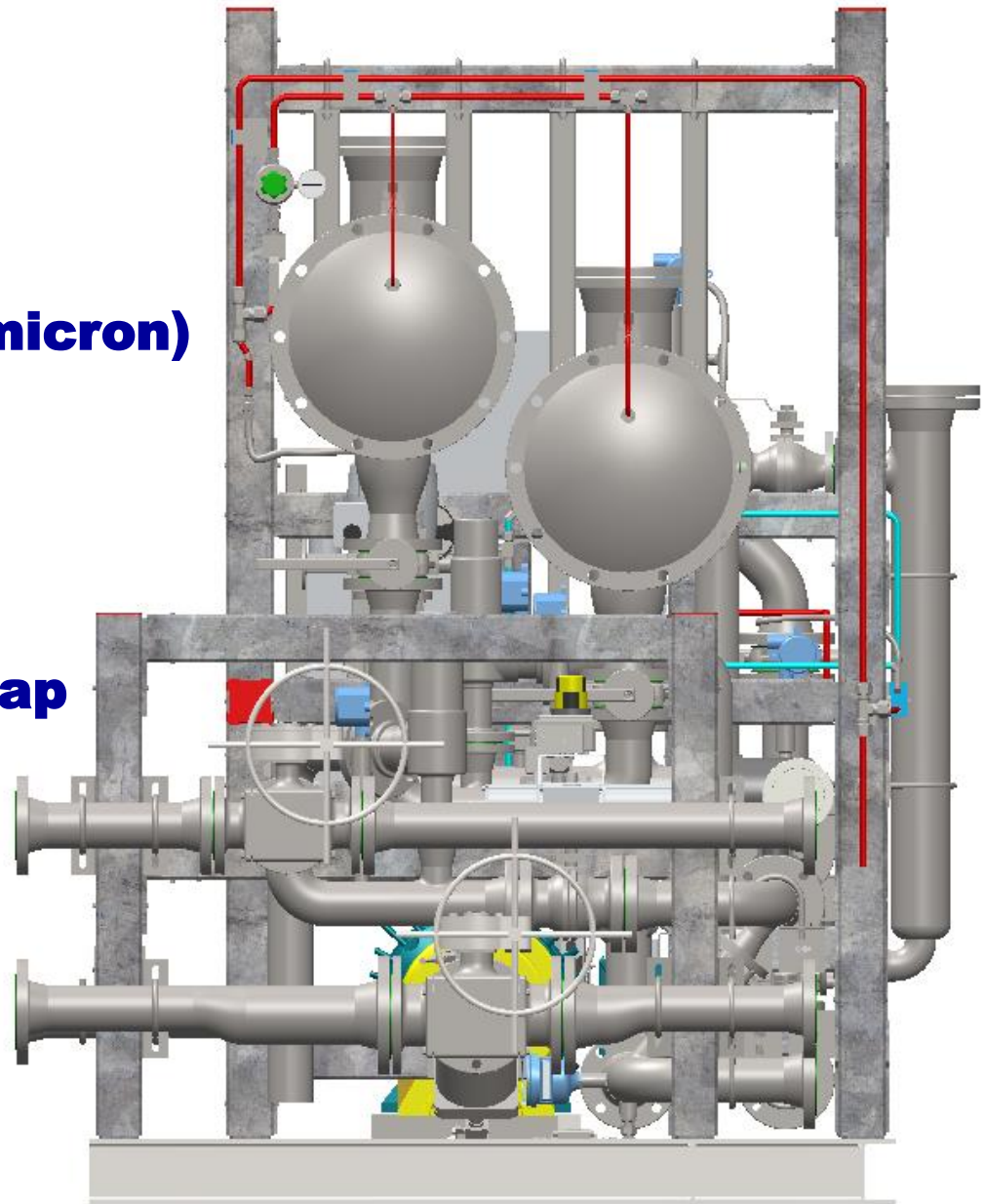
# Filter Skid Construction



# Coarse Filters

**(50 / 25 / 15 micron)**

**Automatic backwash on deltap**





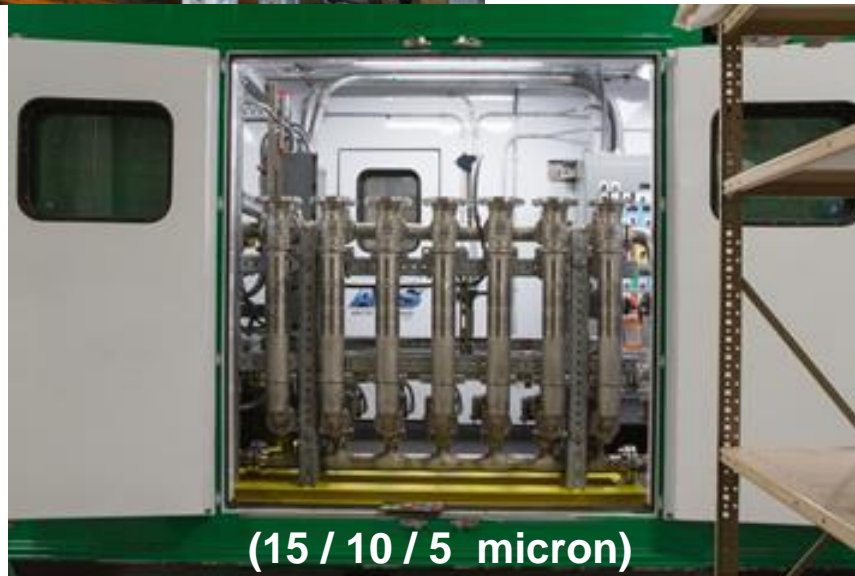
# Fine Filters



Sock filter elements

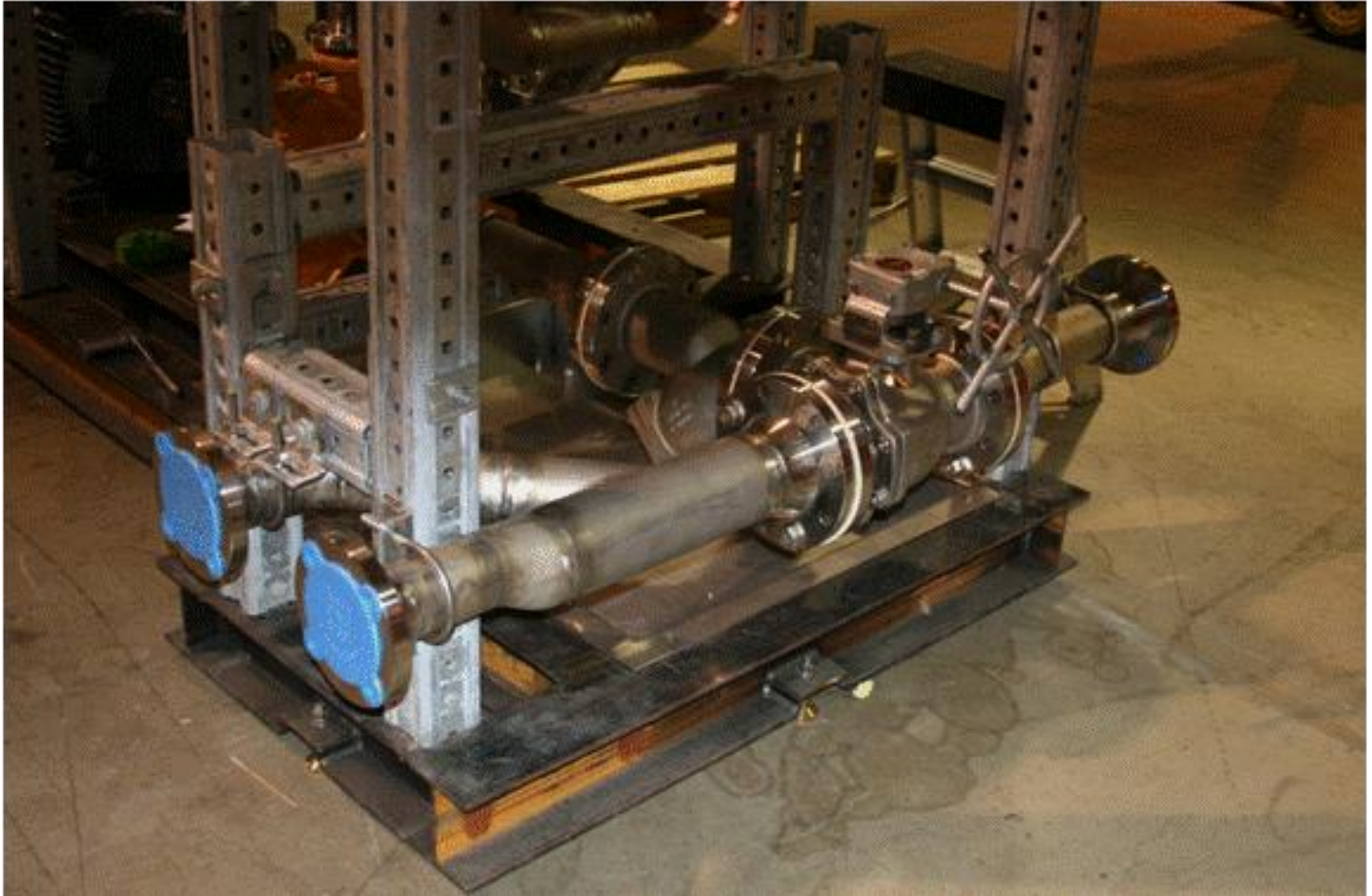


Automatic backwash  
on deltap

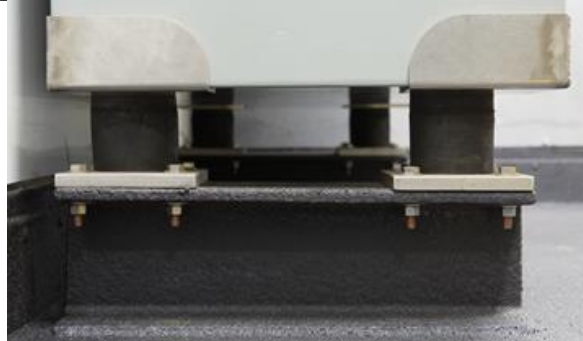


(15 / 10 / 5 micron)

# Inlet/Outlet Piping



# MCP Vibration Mitigation



# Genset with Subtank



# Genset Room



# Genset Exhaust Penetration



# Interior & Exterior Lighting



# Shore Power Option



# XHHW-2 Wire Rated for Extreme Cold





# Auxiliary Equipment



Thermostats



Heaters



Ground reels

# Enclosure Inspection



# Transport Preparation



# End View



# Versatility of Skid/Trailer Design



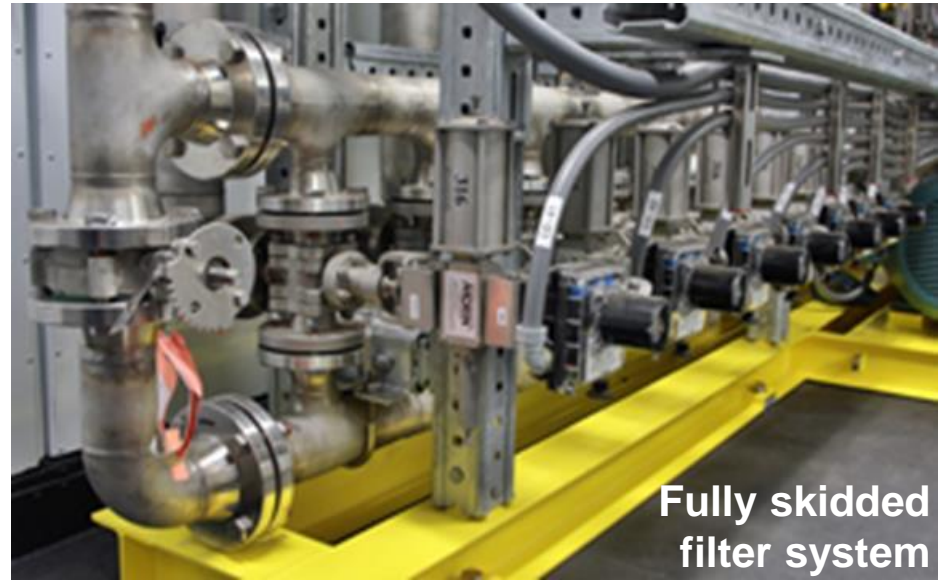
# Trailer Transport



# Automatic Filtration System



40 hp mag drive pump



Fully skidded filter system



Backwash valving

# Equipment Installed





# Future Directions

- ◌ Chemical pre & post treatment
- ◌ Customization & standardization
- ◌ Decreased build time
- ◌ Decreased development cost
- ◌ DCS communications
- ◌ Enclosure venting
- ◌ Expansion capability
- ◌ Finer solids filtration and water treatment
- ◌ Fire & gas protection systems
- ◌ Hazardous environment
- ◌ Multiple units



- ◌ Multiple uses
- ◌ Non-arctic design
- ◌ Ongoing operation & maintenance support
- ◌ Over pressure protection notifications
- ◌ Remote alarming
- ◌ Lessons learned



# ***SAVING TIME, MONEY & RESOURCES***

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# The End

