NPOI Nitrogen Distribution
Concept Generation and Selection

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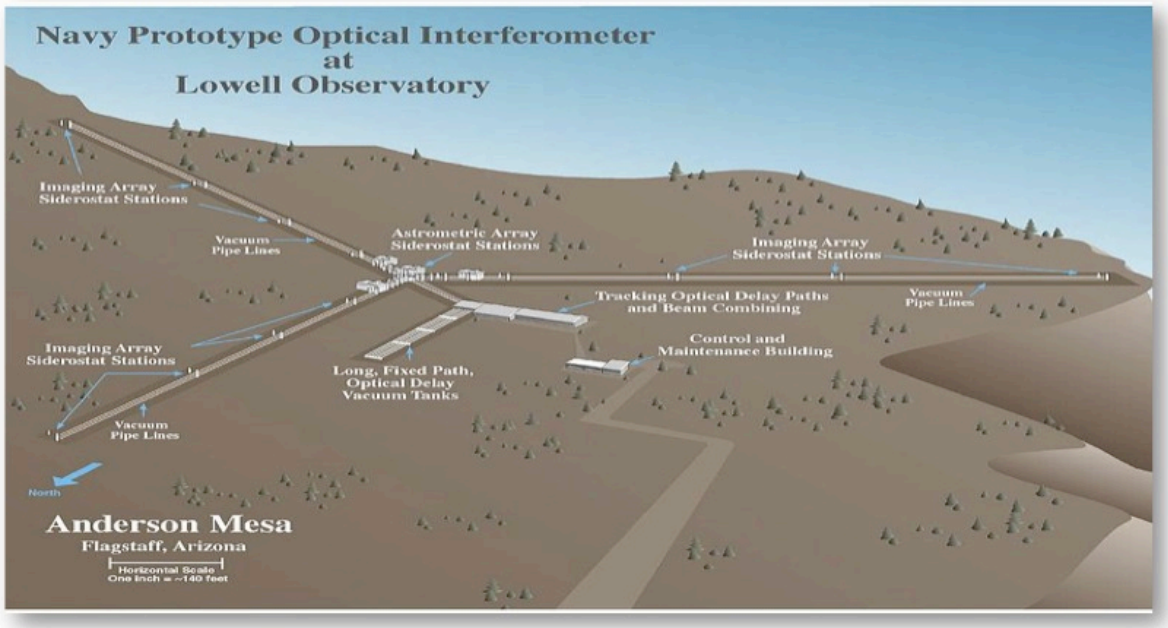
Overview

- Project Overview
- System description
- Tubing selection
- Distribution style
- Valve selection
- Conclusion

NPOI

- Maps the location of stars
- Requires nitrogen to operate actuators and keep debris off mirrors



System Description

- 1000L Dewar tank of nitrogen at center
- 3 300m runs of tubing
- 11 manifolds with 5 ports on each run
- Manual valve prior to each manifold
- 10CFH at 60PSI in each run

Copper

- Available as cleaned and capped
- Thin wall thickness (0.032in)
  - Vibrations
  - Punctures
- Solder joints

Cerro Flow Products

316 Stainless Steel

- Strong
- Extremely resistant to outside elements
- Butt weld fittings

Micah & Co.

EPDM Tubing

- Low cost
- Available with crimped fittings

Weighting Criteria

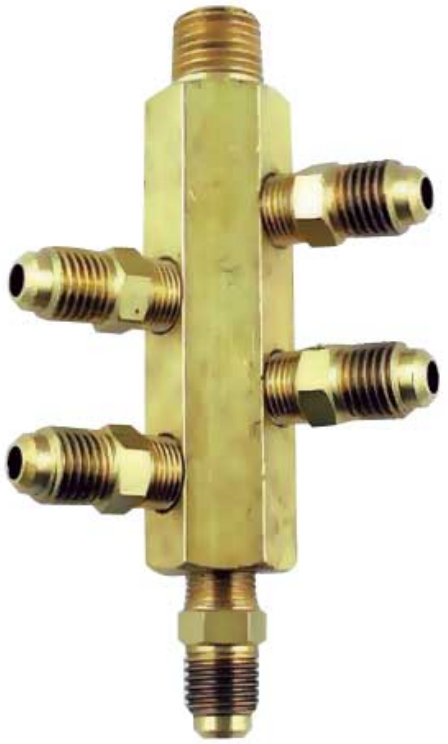
	Current Supply	Cost	Ease of Installation	Maintenance	Environmental Constraints		Final Weight
Current supply	0	0	0	0	0	0	0
Cost	1	0	0	0	0	1	11%
Ease of Installation	1	1	0	0	0	2	22%
Maintenance	1	1	1	0	0	3	33%
Environmental Constraints	1	1	1	0	0	3	33%

Supply Line Decision Matrix

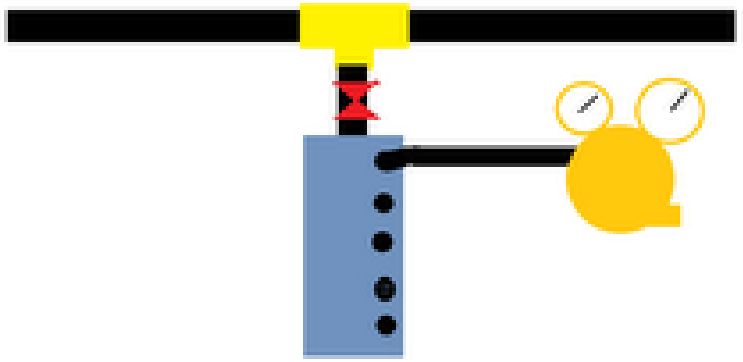
	Cost	Ease of Installation	Maintenance	Resistance to Surrounding	
Copper	4	3	5	4	4.07
316 Stainless Steel	1	2	4	5	3.52
EPDM	3	5	3	3	3.41
	11%	22%	33%	33%	

Tee to Manifold

- Tee from main line to 5 port manifold at each location
- Requires:
  - 11 valves
  - 11 tees
  - 11 tubes from tee to manifold
  - 11 tube to FPT fittings
  - 11 manifolds



Tee to Manifold Example



Individual Tees

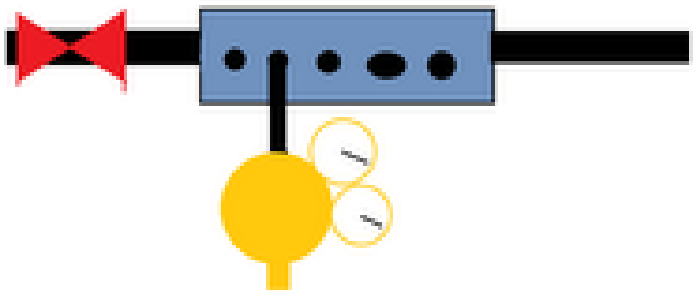
- Has 5 individual tees in supply line at each location
- Requires:
  - 55 valves
  - 55 tees
  - 55 tubes from tee to regulato
  - 55 tube to FPT fittings

Flow Through Manifold

- Manifold is installed directly into supply line
- Requires:
  - 11 valves
  - 11 manifolds
  - 55 MPT to pipe fittings
  - 55 pipe to FPT fittin

www.directpex.com

Flow Through Manifold Example



System Configuration

	Cost	Ease of Installation	Maintenance	Resistance to Surroundings	
Tee to Manifold	3	3	5	5	4.07
Individual Tees	2	1	2	2	1.65
Flow Through	2	2	3	3	2.53
	11%	33%	22%	33%	

Shutoff Valve

- Must be free flowing
- Easy to shutoff
- Inexpensive

$$Equivalent\ length: L_{eq} = \frac{K_L D}{f}$$

$$Minor\ losses: h_L = K_L \frac{V^2}{2g}$$

Ball Valve

- Easiest to operate
- Most efficient
- K= 0.05

Zoro Tools

Gate Valve

- Adjustable flow rate
- Relatively free flowing
- K= 0.15

Sears

Angle Valve

- Useful if sharp bend at location
- Restrictive
- K= 2

NIBCO

Valve Decision Matrix

	Cost	Ease of Operation	Maintenance	Flow Restriction	
Ball Valve	4	5	3	5	4.4
Gate Valve	3	3	2	4	3.08
Angle Valve	3	3	2	3	2.75
	11%	33%	22%	33%	

Tubing Size Decision

- Tubing size is dependent on flow rate and allowable pressure drop
- Pressure drop is dependent on equivalent length, diameter, fluid properties, and Reynold's number

Tubing Size Equations

$$Pressure\ Loss: \Delta P = f \frac{L_{eq}}{D} \frac{\rho V^2}{2}$$

$$V = \frac{Q}{A}$$

Friction factor, f is obtained from the Moody diagram using the Reynold's number

$$Re = \frac{\rho V D}{\mu}$$

Tubing Calculation

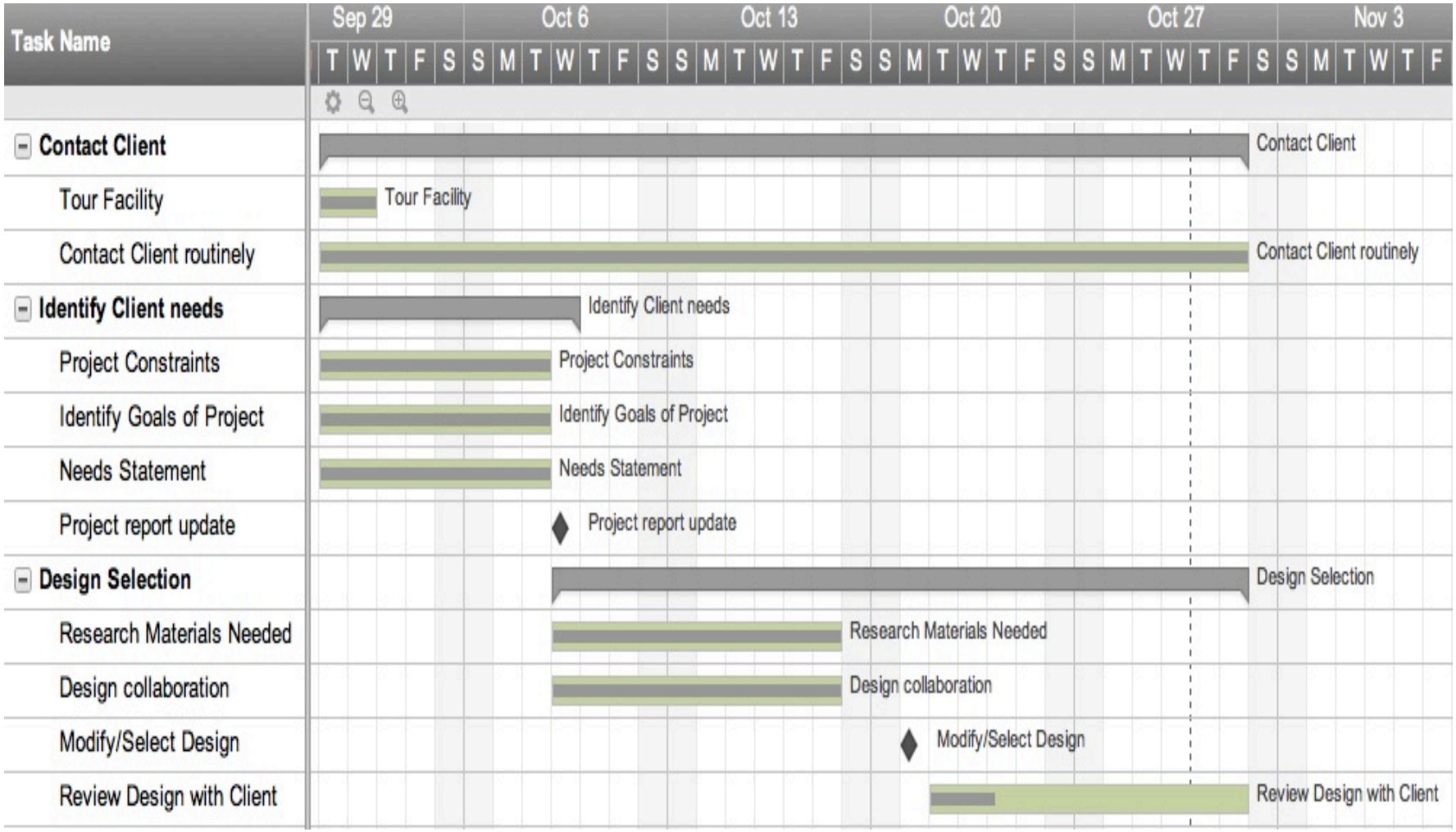
```
>> Tubingsize
What is diameter?0.311
How many tees?11
How many valves?11
What is line pressure?60
Equivalent length=
  301.9618

Total Pressure Drop
   22.0117

>> Tubingsize
What is diameter?0.436
How many tees?11
How many valves?11
What is line pressure?60
Equivalent length=
  302.5099

Total Pressure Drop
    4.4621
```

Gantt Chart


Task Name
Sep 29
Oct 6
Oct 13
Oct 20
Oct 27
Nov 3
T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F
Contact Client
Tour Facility
Contact Client routinely
Identify Client needs
Project Constraints
Identify Goals of Project
Needs Statement
Project report update
Design Selection
Research Materials Needed
Design collaboration
Modify/Select Design
Review Design with Client

Conclusion

- Copper tubing will be used due to corrosion resistance, cost, and low maintenance.
- A tee will supply a 5 port manifold at each location due to simplicity, cost, and low maintenance.
- Ball valves will be used because they are less restrictive and easier to operate than the others.

References

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