Large Scale Process Modules
First in Place Technology

Detlef Kehm, PhD
VP Site and Project Engineering
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Agenda

• Project Introduction
  – Statistics, Design Objectives, Technology

• Considerations for Process Modules

• Building Layout

• Implementation of Large Scale Process Modules / Super Skids

• Summary
Project Scope and Objectives

• Human Blood Plasma Fractionation Facility

• Grass Root project in NC
  – Site & Infrastructure expansion
  – Production Facility (155,000 sq ft)

• Investment
  – Capital $ 380 MM
  – Expense $ 50 MM

• Quality
  – Maximize Closed Processing
  – Minimize Human Intervention

• Throughput
  – Double Production Capacity
  – Achieve Aggressive Schedule

• Efficiency
  – Double Batch Size
  – Minimize Clean Rooms
  – High Level of Automation
Plasma Fractionation Technology

1. COLLECTION
2. POOLING
3. FRACTIONATION
4. PURIFICATION
5. FILLING

(14) Precipitation Tanks
(8) Centrifugation Skids
Considerations for Process Modules

- Plasma fractionation process utilizes many repetitive process operations (Examples: Precipitation, Separation, CIP)
- Project introduced “first in place” separation technology by implementing custom made Westfalia disk stack centrifuge
- Aggressive project schedule did not allow for traditional construction approach

Decision was made in conceptual design to maximize the utilization of modular construction
Building Layout Concept

• First floor
  - Warehouse and utilities
  - Standard skids - CIP, WFI generation, etc.

• Second floor
  - Process Equipment
  - Super skids – (14) Precipitation Tanks, (1) Buffer Preparation/Hold, (8) Centrifuge Piping

• Third floor
  - HVAC
  - Standard skids - Pipe racks, etc.
Building Layout - Second Floor
On Site Super Skid Fabrication

- Complete Super Skid assembly on-site in dedicated shop
  - All equipment shipped to site
  - Structural frames partially fabricated off-site (Puerto Rico)
  - All skid piping pre-fabricated at off-site shop (Puerto Rico)
  - Final assembly and shop welds completed on-site
- Specialized trades and crafts supplied by UPSI
Process Module: Precipitation Tanks
Process Module: Precipitation Tanks

- **Dimensions**
  - WxLxH 46’x120’x26’

- **Weight**
  - 760,000 lbs

- **Equipment**
  - 14 Tanks (13 m³)
  - 21 Pumps
  - 19 Valve skids

- **Skid Fabrication**
  - 190,000 hrs

- **Piping**
  - Hygienic 6,655’
  - Non-Hygienic 3,452’
  - Welds 9,400
    - Off-site Shop 7,050
    - On-site Shop 2,050
    - Field Welds 300

- **Valves**
  - Manual Valves 750
  - Instrument Valves 660
Precipitation Tank Skid Transport
Process Modules: Centrifuge Piping
Process Module: Centrifuge Piping

- **Dimensions**
  - WxLxH 10’x15’x18’

- **Weight**
  - 30,000 lbs

- **Equipment**
  - 1 Tank (0.75 m³)
  - 7 Pumps
  - 4 Heat Exchangers

- **Skid Fabrication**
  - 22,000 hrs

- **Piping**
  - Hygienic 890’
  - Non-Hygienic 840’
  - Welds 3,450
    - Off-site Shop 2,600
    - On-site Shop 850
    - Field Welds 0

- **Valves**
  - Manual Valves 200
  - Instrument Valves 150
Centrifuge Piping Modules

- (7) identical skids with high level of automation
- Skid functionality (software and mechanical) was unproven and increased project risk
- Early fabrication of first skid allowed testing and debugging prior to remaining skids’ completion
- Software testing continued until all remaining skids were built and installed in building

Skid approach decreased risk and allowed schedule improvement
Summary

- Construction schedule compressed by (4) months
- New centrifugation technology started up without mechanical rework
- Costs savings achieved - 15% of Budget

Building must be designed for process module approach in conceptual design
Repetitive process steps beneficial to maximize standardization
Modular Construction for Process Skids

- **Standard Equipment Skids**
  - Built, tested, and completed off-site
  - Size allows for normal road transportation

- **Modular Off-Site Skids**
  - Built, tested, and completed off-site
  - Some disassembly needed for road transportation

- **Modular On-Site Skids (Super Skids)**
  - Built, tested, and completed on-site
  - Maximum height limited by building floor elevation
Benefits of Super Skids

• Build completely out of place
  – Controlled conditions in fabrication shop leads to higher quality and safer environment
  – Reduced congestion and coordination in the building
  – Increased productivity due to high quality of specialty workforce

• Simultaneous construction of Building including Infrastructure and Process Modules
  – Overall integrated schedule compression

• Large “off shore” pool of resources can be utilized concurrently

• Standardization leads to assembly line approach
Buffer Prep/ Hold Skid Statistics

• Dimensions
  - WxLxH 26’x27’x19’

• Weight
  - 44,400 lbs

• Equipment
  - 3 Tanks
  - 4 Pumps
  - 1 Valve Skid

• Skid Fabrication
  - 26,800 hrs

• Piping
  - Hygienic 740’
  - Non-Hygienic 610’
  - Welds 1,520
    - Off-site Shop 1,180
    - On-site Shop 240
    - Field Welds 100

• Valves
  - Manual Valves 110
  - Instrument Valves 90