Plant FEED 및 초기설계에의 최적설계 자동화

The Technology Leader in Knowledge Based Plant Design Solutions for Front End Engineering and Design (FEED) Projects
- FEED
- OPD SUITE
  Optiplant configurator
  PR-MS/PR-PD MS
  PSO (Pipe Support)
  Import Router
- FEED to Detail design Work Process
- Experience and Samples
ASD Company Overview

**ePlantSolutions**
- Started in 1982, with a focus on providing Knowledge-based Engineering and Automation solutions for the Plant Industry
- Established a strong track record for providing services, solutions and innovative products for the Plant Industry

**Public Sector**
- In 1998, expanded to and started a Public Sector division – to provide services and solutions for the Federal and State markets

**Construction Services**
- In 2005, expanded to and started an office in Dubai to provide engineering services and solutions for the Middle East Engineering and Construction Industry
ASD Technology Applications

적용분야
- Offshore
- Petrochemical
- Power
- Chemical
- Pharmaceutical

적용단계
- Proposals
- Site Optimization
- Plot Plan Optimization
- FE L
- FEED
- Early Detail Design
Business Drivers and Challenges facing FEED Projects Today
Proposal, Conceptual, FEL and FEED Stage Project Challenges

- 보다 정확한 견적, 더 높은 품질 요구
- 정보는 완성되지 않은 채, 수시로 배치와 배관스펙이 변한다.
- FEL 과 Detail Design의 통합이 요구되고 있다
- 값비싼 재료, Tight한 이익 margin
FEED에 현재방법사용시 문제점

Manual Design시의 문제점
- 부정확, 불연속성
- 재활용이 안된다
- 3D Model이 아니어서, 2D paper 결과물만 생성
- Arrangement or Process 의 변경에 신속한 변경이 어렵다

기존 3D 상세설계 tool 사용시(PDS, PDMS, SP3D 등)
- 많은 전문인력이 필요하며, 많은 경비와 인력이 쇼요
- Arrangement or Process 의 변경에 대처할이 미흡
- 설계자의 숙련이 품질에 영향
- 방대한 스펙 구축과 ADMIN Support 및 교육훈련 필요
For a sample 6000 line project, the **Black** timeline is using conventional methods and the **RED** timeline is with using ASD’s solutions.

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<td>Model Review with Client</td>
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Schedule float of 2 months available by utilizing ASD’s solutions.
ASD Products and Services
Optiplant Plant Design Suite (OPD Suite)
• Optiplant Configurator (Optiplant)
• PR-MS (PipeRouter Microstation)
• PR-PDMS (PipeRouter PDMS)
• PSO (Pipe Support Optimizer)
• Import Router
<table>
<thead>
<tr>
<th></th>
<th>Proposal / FEED</th>
<th>DETAIL</th>
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</thead>
<tbody>
<tr>
<td>Optiplant</td>
<td>• 정확한 MTO</td>
<td>• 1st MTO</td>
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<td>• 3D 결과물</td>
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<td>• Re-usable in Detail</td>
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<tr>
<td>Pipe Router</td>
<td>• 정확한 MTO</td>
<td>• Preliminary design</td>
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<tr>
<td></td>
<td>• 3D 결과물</td>
<td>• Increase efficiency of non-3D users</td>
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<td>• 상세 설계에 재사용</td>
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<tr>
<td>Import Router</td>
<td>Centerlines → conversion to PDS / PDMS</td>
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<tr>
<td>PSO</td>
<td>Automatic support selection &amp; stress analysis</td>
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OptiPlant Configurator

특징
- FEED와 견적용으로 사용
- 개념설계단계의 기기, 구조물 모델링
- 자동 3D 라우팅
- 신속한 plot plan 최적화
- 정확한 MTO 산출 (area별, 라인별, 스펙별)
- 생성된 모든 데이터 PDS, PDMS, Plantspace 로 전이하여 상세설계에 활용.
- 배관 설계 각종 rule 적용
- Rule 이 적용된 노즐

이점
- 쉽게 익힐 수 있다
- 자동해석 도구들
- 자동으로 ISOmetric DWG 산출
- Piping Expert 덜 필요함
- 산출물검토를 모델리뷰로 함
- 견적물량산출시 시간이 절반정도 소요 됨
OptiPlant Features – Knowledge Base

Thermal Analysis
- Thermal analysis - calculates the displacement due to thermal expansion
- leg length, bend, or elbow to provide flexibilities
- Guided cantilever method - provides the necessary flexibility arm length

Fluid Head Loss Analysis (V 4.5 from now)
- Head loss analysis - considers the friction coefficient based on pipe size and pump size

Pipe Support Analysis (PSO feature)
- Pipe support location selection, appropriate pipe support type selection, pipe and anchor stress analysis (thermal stress, gravity, wind, seismic consideration)

Structural Load Analysis (to be added, 2011.4 estimated)
- Structural load distribution due to piping load on rack and vertical frame
- equipment type 따른 Rule-based nozzles
- Tower Hugging
- Common bottom of pipe elevations for off-rack pipes
- Pipes route on different rack levels based on process or utility designations
- Pipe rack에서 필요시 자동으로 45 deg bend 사용
- Nozzle에서 flange, gasket, 1 long-radius elbow 를 고려함
- 평판배관에서 intake distance, walkway clearance, expansion loops 등 고려
- Air-cooler configurations – symmetrical distribution or single header distribution
- 배관간의 간격 고려
- Pipe rack 배관간격 고려 (insulation, rack-shoes, offsets the flange 등 고려)
- Minimum rack entry / exit rule can be defined
- Underground piping
- Control valve & PSV 위치지정 가능
- 빌딩안의 수직 배관
- 1/2” ~ 80” 배관 라우팅
- 배관 sequencing에 cryogenic piping 고려
- Bypass를 자동으로 한다(to be added)
Minimize Plant Materials, Steel, Piping, Hangers

- Layout requirement 에 맞추어 기기 배치 최적화 (v 4.5)
- Pipe rack structure 최적화
- 값비싼 배관을 먼저 고려함 (material, size, temperature)
- 최단거리 선정
- pipe bends 최소화
- hanger supports 최소화
- Maintenance and Constructability review
- Floor and wall penetration cost analysis (v.4.5)
- Supportability cost
- Free space has high cost
OptiPlant Work Process

Data Preparation
- Paper or CAD PFDs / P&IDs
- Equipment Dimensions
- Plot Plans
- Line List
- Component List

Project Execution
- OptiPlant Configurator
  - Break Model into Units
  - Model Equipment and Structures
  - Nozzle Locations Generated by Built-in Rules
  - Batch Line Routing with Inline Components
  - Engineering Validation
- Refinement of Piping Routes

Deliverables
- Extract MTO per Region, Area, Plant Summary or Line-by-Line
- Include Cost and Weights
- Isometrics
- Structural BOM
• Rule Based Nozzles

• For Rule Based Nozzle (Mode-5)

• Tower

• Horizontal Exchanger

• Horizontal Drum
### ASD Pipe Router

#### 特性
1. PDMS 또는 MicroStation을 위한 응용프로그램
2. 기존 PDMS / PDS 구조물, 배관 재사용
3. Rule-based Nozzles 과 Actual Nozzles 동시사용
4. Knowledge Base of Best Practices
5. 수동으로 Routing 변경

#### 산출물
1. Piping MTO’s (by Area, Region, Line, etc.)
2. 2D Plot-Plans and Isometrics.
**OPD (Optimized Plant Design)**

**Pipe Support Optimizer**

- **특징**
  1. 자동으로 support 최적위치 선정,
  2. 자동으로 support 타입 선정.
  3. 다양한 Loads 조건에 따른 응력해석.
  4. PDS, PDMS, OptiPlant 와 Pipe Router와 연계가능

- **산출물**
  1. 상세 응력해석 Report
  2. Pipe Support Optimization Report
  3. Stress Isometrics
  4. Caesar II Neutral File

- **이점**
  1. 배관 부서와 응력해석팀간의 반복 작업을 줄여줌
  2. 상당수 배관을 배관설계자가 자동으로 응력해석을 실행
배관응력해석 업무 프로세스

**FEED**
- **Optiplant**
  - Pump Loops
  - Expansion loops
  - Elbow Stresses
- **Pipe Router**
  - Pump Loops
  - Expansion loops
  - Elbow Stresses
- or

**Detail Design**
- **PDS**
- or
- **PDMS**
- Pipe Centerlines
- Pipe Intelligence
- Structures

**From Stress Group**
- Nozzle Load Allowables
- Pipe Movement Allowables

**To Stress Group**
- Support Locations
- Complete Analysis in CAESARII

**PSO**
- **Batch Execution**
  - Select batch
  - Set properties
  - Review results

- **Deliverables**
  - Pipe Pass / Fail for what condition
  - Stress ISO
  - Stress Reports

**PASS**
- FAIL
ASD Import Router

특징

■ Microstation 및 PDMS 를 위한 응용 소프트웨어.
■ Manually 입력한 일반라인을 3D intelligent pipe 로 변환하여 PDS나 PD MS로 입력가능

이점

■ PDS와 PDMS 를 전혀 모른 사람도 이 프로그램을 활용해 모델링 가능함으로서 인력확보의 이점과 MH 절감효과가 있음
■ 이 기능은 Pipe-Router 에 기본적으로 있는 기능이나, 고객의 요청에 의해 별도로도 분리해서 판매함 즉, Pipe-Router는 소량 구입하고, Import Router만 저렴한 가격으로 구매하여 사용
FEED to Detail Design Work Process
• For a sample 1000 line project, the **Black** timeline is using conventional methods and the **RED** timeline is with using ASD’s Services

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<td>3D Modeling in Detail design tool</td>
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• By utilizing ASD’s technology and work process, critical savings can be achieved in:
  • Number of Software Licenses
  • Number of Resources
  • Overall Manhours
OptiPlant to Detail Design Work Process

**Initial Plot-Plan Stage**
- ASD OptiPlant
  - 3D Conceptual Model for Equipment, Structures & Piping
  - Rule Based Nozzles
  - Multiple Plot-Plans Reviewed
  - Complete Scope of lines included
  - High quality MTO and Design

**After PDS/PDMS is Setup with more Data**
- ASD Pipe Router
  - Reads in as Input 3D Equipment with Nozzles & Structure from PDS/PDMS
  - Automatically route 3D Piping to actual Nozzles, interference free
  - Update Model as P&ID’s are developed and issued
  - Complete Scope of Lines included
  - High quality MTO and Design

**Detail Design**
- PDS/PDMS
  - 3D Equipment Modeling
  - 3D Structures Modeling
  - 3D Critical Piping

**Data Transfer from ASD Pipe Router to PDS/PDMS**
- 3D Pipe Centerline, clash-free
- Spec Driven Pipe, Elbows and Branches
  - Process Information: ID, Size, Spec, Pressure, Temperature & Insulation

- PDS/PDMS
  - Complete Detailing of Pipe: Vents, Drains, Instruments, Flanges, etc.
Integration with PDS, PDMS

AVEVA P&ID
- Piping Data
  - <XLS> Format

PDMS
- Piping Data
- Equipment Date
- Structural Data
  - <PML Macro> Format

OptiPlant
- Automatically Generates Linelist

SmartPlant P&ID
- Piping Data
  - <XLS> Format

SmartPlant 3D
- Piping Data – Phase I
- Equipment Date – Phase II
- Structural Data – Phase II
- XML – ISO15926

Pipe Router
- Equipment
- Structure
- Pipe
  - <PML Macro> Format
- Pipe
  - <DGN>&<.txt> Format

PDMS
- Equipment
- Structure
- Pipe
  - <PML Macro> Format

3D Model

PDS
- Pipe
  - <APL> Format
- Pipe
  - <DGN>&<.txt> Format

3D Equipment & Structures

3D Model
Project Experience; Offshore, FPSO, Refining, Chemical, Petrochemical, etc.
ASD Project Experience

Gas Plant - Proposal

Hydrotreater Unit - Benchmark

Coal to Gas Plant - FEED

Floating Production, Storage and Offloading - FEED

Offshore Platform Topside – Cost Estimate

Site Optimization & Rack Study
Client Objective – FEED Stage for a Refinery

- Provide SNC-Lavalin Project Team with ASD OptiPlant to improve on PDS Method
- FEED Project for the Northwest Upgrader; Total of 18 Areas, 2000 Equipment, over 6000 Lines
- Verify Design Assumption, Develop P&ID's and Optimize Plot-Plan
- Deliver an accurate MTO (+/- 10%) within 9 month schedule

Advantage with ASD OptiPlant Configurator

- OptiPlant used by 9 designers vs. 22 required for PDS
- Executed Production training for 4 days and immediately started project work – Easy to use
- Modeled all 18 Areas for Equipment, Structures, and Piping
- Able to keep-up with P&ID and Plot-Plan changes effectively – Could not have done this with PDS within the man-hours or schedule
- Efficient Responsiveness to Customers Changes
- Delivered accurate MTO and quality design on schedule
- Flexibility to work more than one layout option and review comparisons
- Effectively used existing resources – Sr. and Jr. Designers
- Pipe Support Optimizer – Reduced man-hours by 50% for optimal support selection for stress critical lines

Article published in Chemical Engineering, February 2008
Project Experience – SNC-Lavaline

Tar Sands Upgrader Facility
Project Experience – AMEC, FPSO

Client Objective – FEED Stage for an FPSO

- Provide AMEC an ASD Project Team to relieve in-house resources and improve on PDMS Methods
- FEED Project for an FPSO; 600 Lines
- Complete 3D Model and Deliverables
- Optimize design for weight and process
- Deliver an accurate MTO (+/- 10%) within 6 week delivery schedule

Advantage with ASD OptiPlant Configurator

- OptiPlant used by one Sr. Designer and two Jr. Designers
- Able to cycle through six P&ID revisions and four Arrangements
- Delivered accurate MTO and a 3D quality design ahead of schedule
- Project success served as basis for a client published Case Study
- Client confirmed that ASD and OptiPlant performed above expectations

Article published in Zeus Technology Magazine, February 2009
FPSo Project
Project Experience – Power Plant

Client Objective – FEED Stage for a Power Plant

- Client Team executed project
- FEED Project – about 400 Lines
- Complete 3D Model and Deliverables
- Optimize design for arrangement
- Deliver an accurate MTO (+/- 10%) within 3 week delivery schedule

Advantage with ASD OptiPlant Configurator / Pipe Router

- OptiPlant used by one Sr. Designer and one Jr. Designer
- Delivered accurate MTO and a 3D quality design on schedule
- Client confirmed that ASD and OptiPlant performed above expectations
Delayed Coker Unit
OptiPlant and ASD Pipe Router
Examples
Example 1

- Routed Specifically to get the offset from the Exchanger Tube to the Header
Example 2

- Nozzles modeled on the equipment to get specific configuration.
Example 3

- Aircooler
  Piping with Expansion Considered
• Example 4
- Example 5
Example 6
Example 7
• Example 8
Example 10