QUE$TOR Offshore

Example 1 – Netherlands

Inputting Prospect Data

Example 1 – Prospect Data

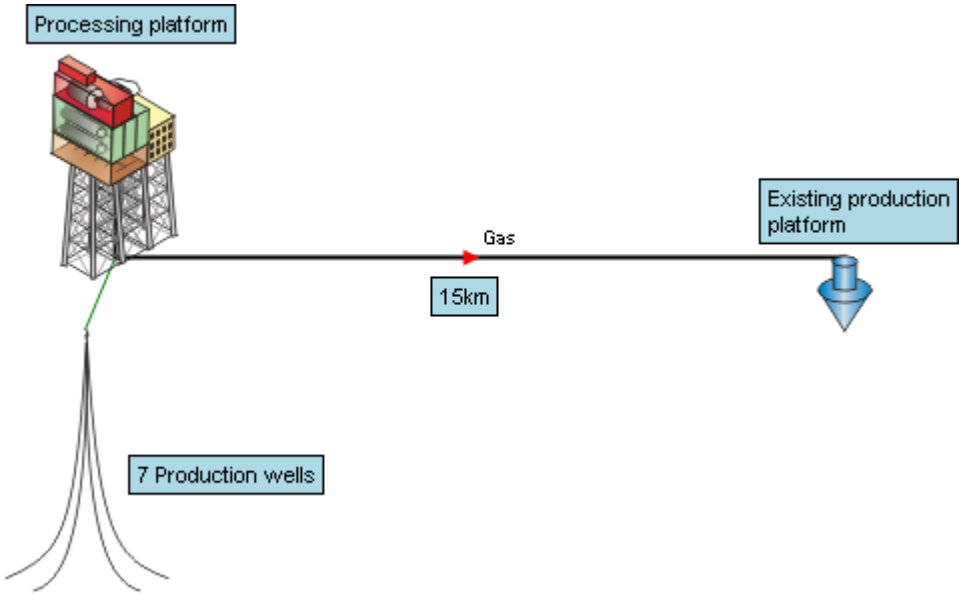
- Input parameters (**Use default if not listed below**)
- Create a new project (*File / New project*)
  - New offshore project
- Project properties
  - Main product – Gas
  - Location – Europe / Netherlands / Anglo Dutch Basin
  - Create new procurement strategy
    - Procurement strategy – Netherlands default (US $)
- Field level data (*Field characteristics*)
  - Recoverable reserves = 350 Bscf (Gas)
  - Condensate gas ratio = 20 bbl/MMscf
  - Reservoir depth = 3000 m
  - Reservoir pressure = 400 bar
  - Reservoir length = 5 km
  - Reservoir width = 4 km
  - Water depth = 40 m

Example 1 – Prospect Data

- Field level data (*Fluid / profile characteristics*)
  - Oil / condensate density = 40 °API
  - CO_2 content = 5%
  - Well productivity = 50000 MMscf/well
  - Peak well flow = 25 MMscf/day
- Field level data (*Miscellaneous*)
  - Distance to operations base = 90 km
  - Distance to delivery point = 15 km
- Production profile (*Production profile edit*)
  - Field life = 10 years
  - Plateau duration = 3 years
  - Plateau rate = 150 MMscf/day

Example 1 – Field Development Schematic

- Concept selector
  - Development concept – Production platform
    - Gas export method – via existing production platform (15 km)
    - Condensate export method – inject into gas line



- Save the project (*File / Save*)

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Example 2 – Angola

Deepwater Concept Options

Example 2 – Prospect Data

- Input parameters (**Use default if not listed below**)
  - Oil field
  - Africa / Angola / Congo fan basin
  - Procurement Strategy – Angola (US $)
    - Materials – Africa

- Field level data
  - Recoverable reserves = 150 MMbbl (Oil)
  - Gas oil ratio = 1000 scf/bbl
  - Reservoir depth = 3000 m
  - Reservoir pressure = 300 bar
  - Water depth = 1000 m
  - CO_2 content = 5%
  - H_2S content = 100 ppm
  - Well productivity = 10 MMbbl/well
  - Peak well flow = 4 Mbbl/day
  - Distance to operation base = 110 km
  - Distance to delivery point = 100 km

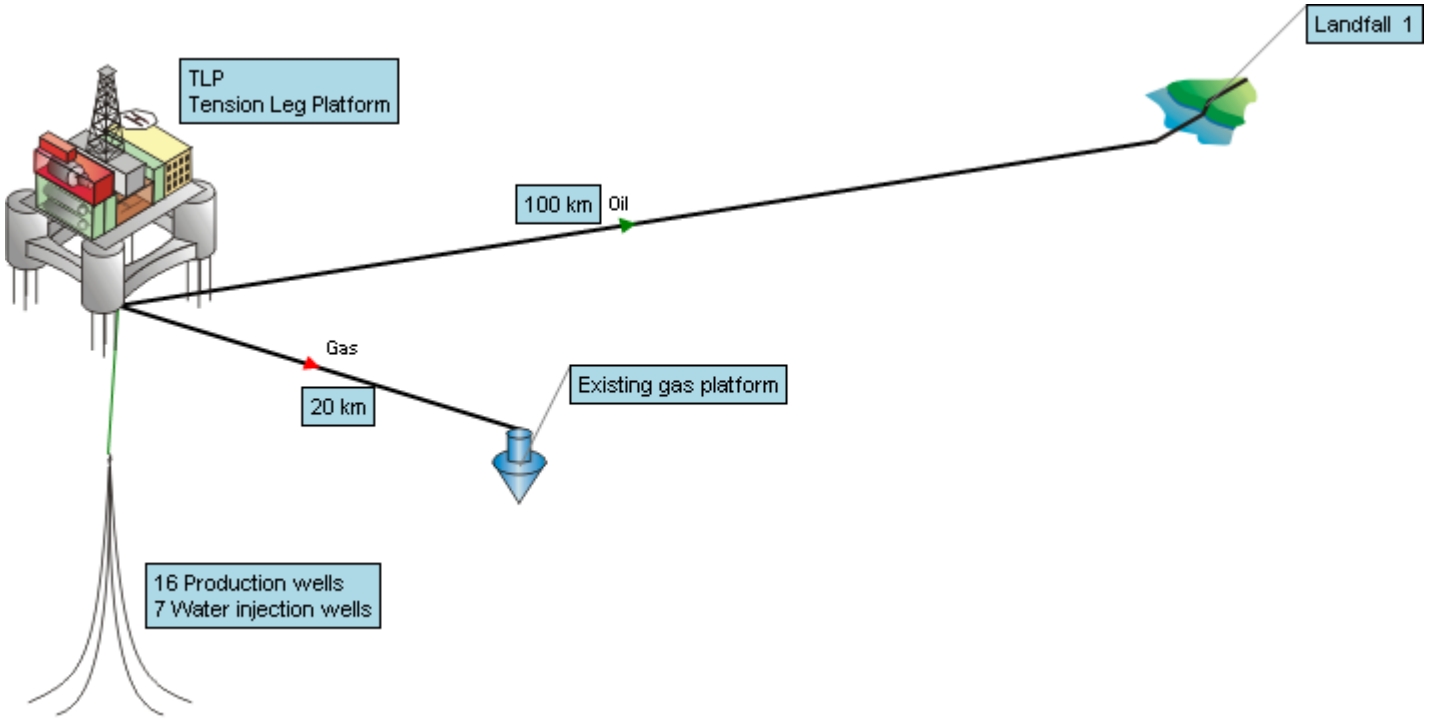
- Production data (*Design flowrates*)
  - No gas injection

Example 2 – Prospect Data

- Oil Export
  - Pipeline material
    - Carbon steel X80 (incld. with Q1 2016 release)
    - Insert comment : changed from X60 to X80 (incld. with Q1 2016 release)
    - Pipeline size : 12”
    - Insert comment : changed line size from 14” to 12”
  - Dry oil tank (incld. with Q1 2016 release)
    - Storage capacity : 1500 bbl
- Five field development scenarios will be created

Example 2 – Field Development Scenario 1

- Development concept – Tension leg platform (TLP)
  - Oil export – Pipeline to shore (100 km)
  - Gas – via existing production platform (20 km)

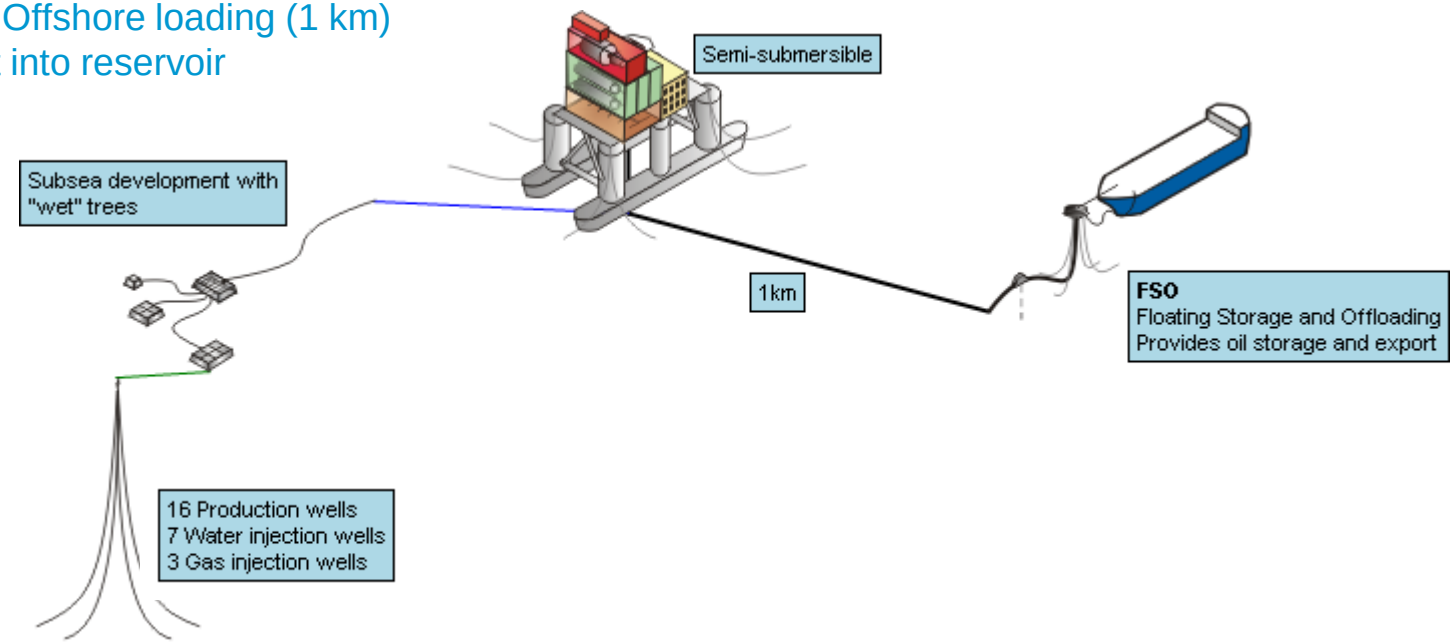


- Note the CAPEX and save the project (*File / Save*)

Example 2 – Field Development Scenario 2

- Gas is reinjected, rather than exported, resulting in greater recovery:
  - Field level data (*Project / Field level data*)
    - Recoverable reserves = 180 MMbbl
    - Well productivity = 12 MMbbl/well
  - Select gas injection (*Project / Production profile / Design flowrates*)

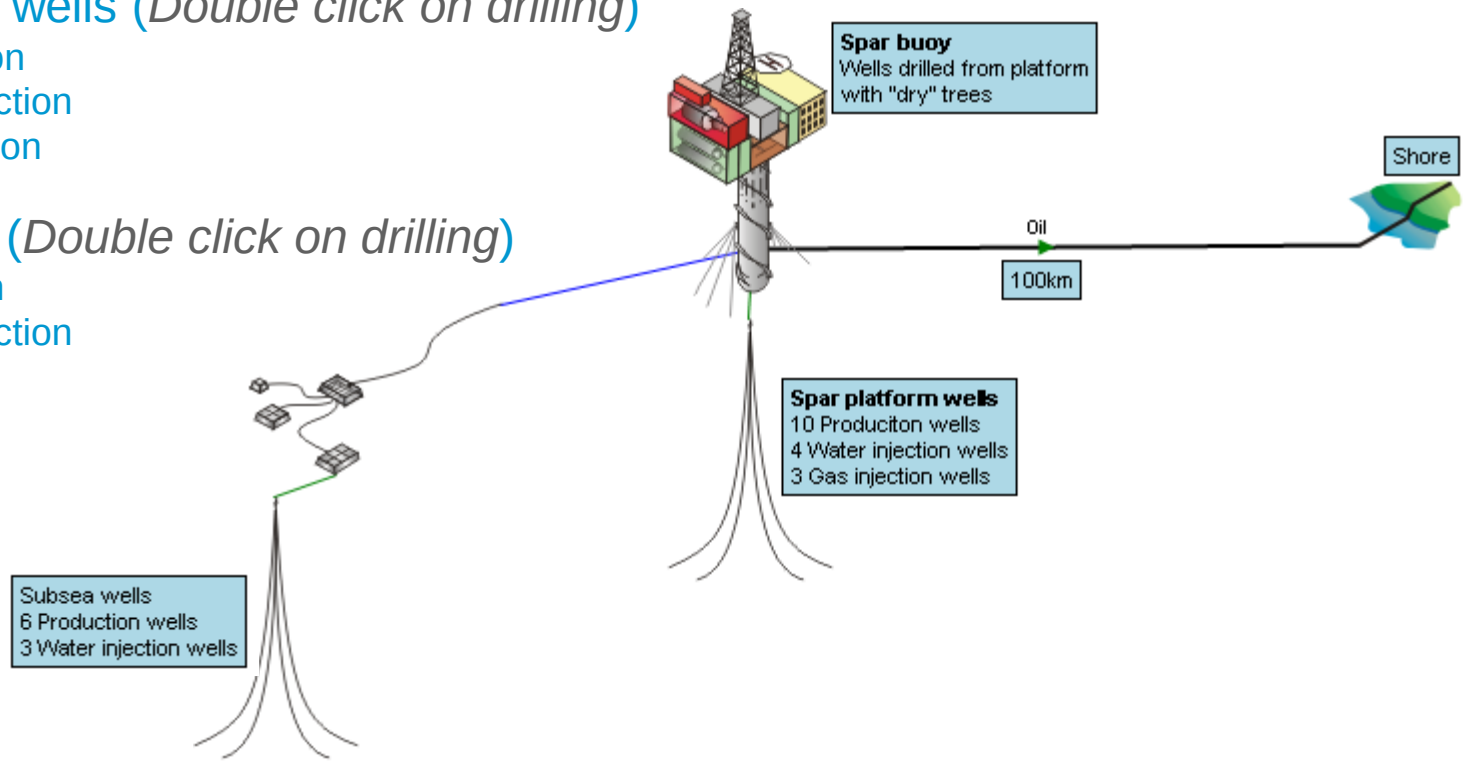
- Concept – Semi-submersible + Subsea tie-back (*Project / Concept selector*)
  - Oil export – Offshore loading (1 km)
  - Gas – Inject into reservoir



- Note the CAPEX and save the project under a new name (*File / Save as...*)

Example 2 – Field Development Scenario 3

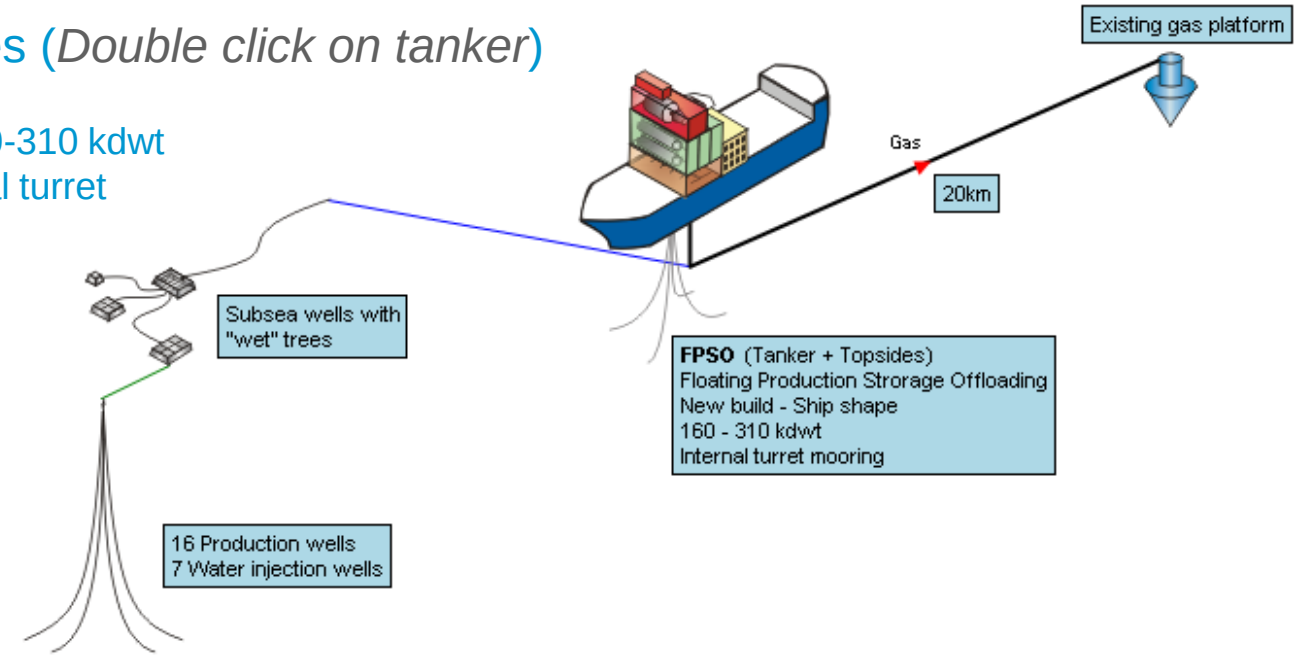
- Development concept – Spar buoy + Subsea tie-back
  - Oil export – Pipeline to shore (100 km)
  - Gas – Inject into reservoir
- Spar platform wells (*Double click on drilling*)
  - 10 Production
  - 4 Water injection
  - 3 Gas injection
- Subsea wells (*Double click on drilling*)
  - 6 Production
  - 3 Water injection



- Note the CAPEX and save the project under a new name (*File / Save as...*)

Example 2 – Field Development Scenario 4

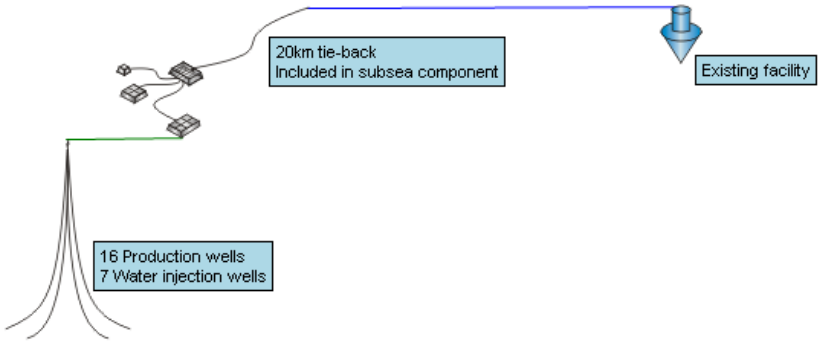
- Gas is exported, rather than reinjected
  - Open scenario 1 to use as basis (*File / Open*)
- Development concept – FPSO + Subsea
  - Oil export – Ship to Ship
  - Gas – via existing production platform (20 km)
- Tanker / FPSO changes (*Double click on tanker*)
  - New build (ship shape)
  - Tanker size = VLCC 160-310 kdwt
  - Mooring option = Internal turret



- Note the CAPEX and save the project under a new name (*File / Save as...*)

Example 2 – Field Development Scenario 5

- Field is tied-back to an existing facility with capacity to handle production
  - Existing facility is 20 km from the field
- Create the concept by adjusting the schematic of concept 4
  - Delete tanker and topsides
  - Use the “Link” component to join the subsea tie-back to the Sink
  - Set the tie-back distance to 20 km within the subsea component (*Subsea / Layout tab*)
    - Check layout in Subsea schematic
- Chemical injection required to prevent hydrates over longer tie-back
  - Select chemical injection in subsea
  - Add HIPPS on commingling manifold



- Note the CAPEX and save the project under a new name (*File / Save as...*)

Example 2 – Project Viewer

- Compare the cost of each project using the project viewer
  - Open the project viewer (*Tools / Project viewer*)
  - Open the projects to compare (*File / Open*)
    - Select all five field development scenarios
  - Sort the projects by Total CAPEX (*Sort options in the toolbar*)
    - Use the comparison tab to see the results
  - Graphs can be created directly within the project viewer
    - Alternatively, everything can be exported to Excel (*File / Export*)

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Example 3 – Brunei

Creating a Field Development Schematic

Example 3 – Prospect Data

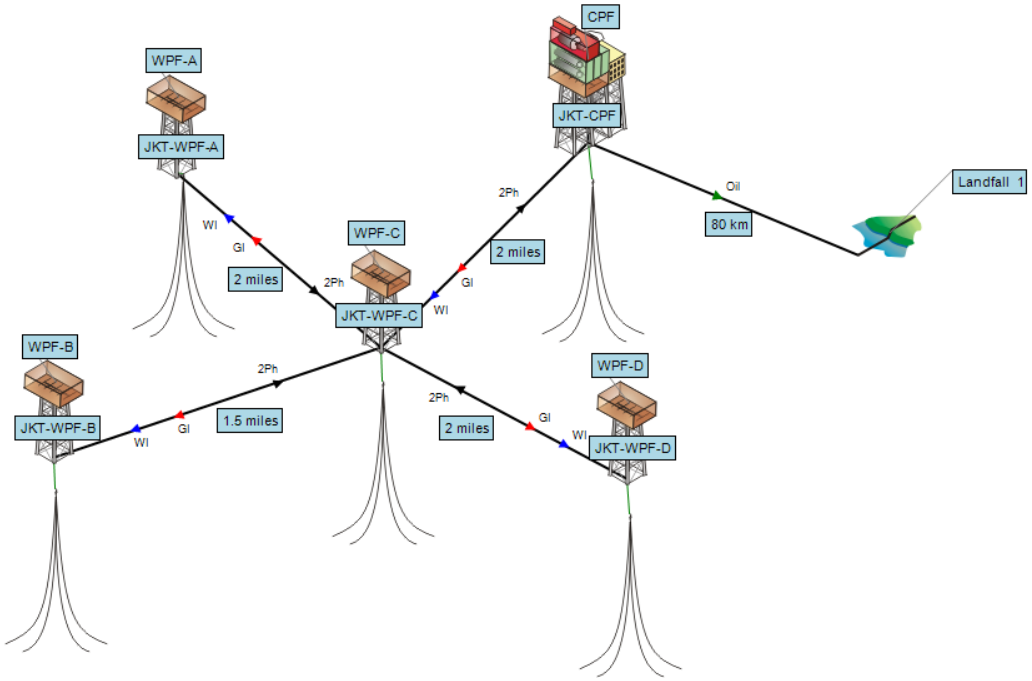
- Input parameters (**Use default if not listed below**)
  - Oil field
  - Far East / Brunei / Baram Delta (US$)
  - Procurement strategy - Brunei
    - Design & Project Management = European

- Field level data
  - Recoverable reserves = 240 MMbbl (Oil)
  - Gas oil ratio = 2000 scf/bbl
  - Reservoir depth = 2400 m
  - Reservoir length = 8 miles
  - Reservoir width = 2 miles
  - Water depth = 80 m
  - Initial water cut = 25%
  - Gas CO_2 content = 8%
  - Well productivity = 7 MMbbl/well
  - Peak well flow = 4 Mbbl/day
  - Distance to operations base = 80 km

- Production data
  - Field Life = 15 years
  - Plateau rate = 100 Mbbl/day
  - Gas is reinjected *(Select gas injection)*

Example 3 – Using a Blank Concept

- Development concept: **Blank Concept**
- Use the component toolbar to create the field schematic below:
  - Ensure the export tabs within the main topsides is set correctly (*Oil pipeline to shore / Gas injected into reservoir)*
  - Infield lines- change to flexible (incld. Since Q3 2015)
  - Power cables from central processing facility to wellhead platform (incld. since Q1 2014)



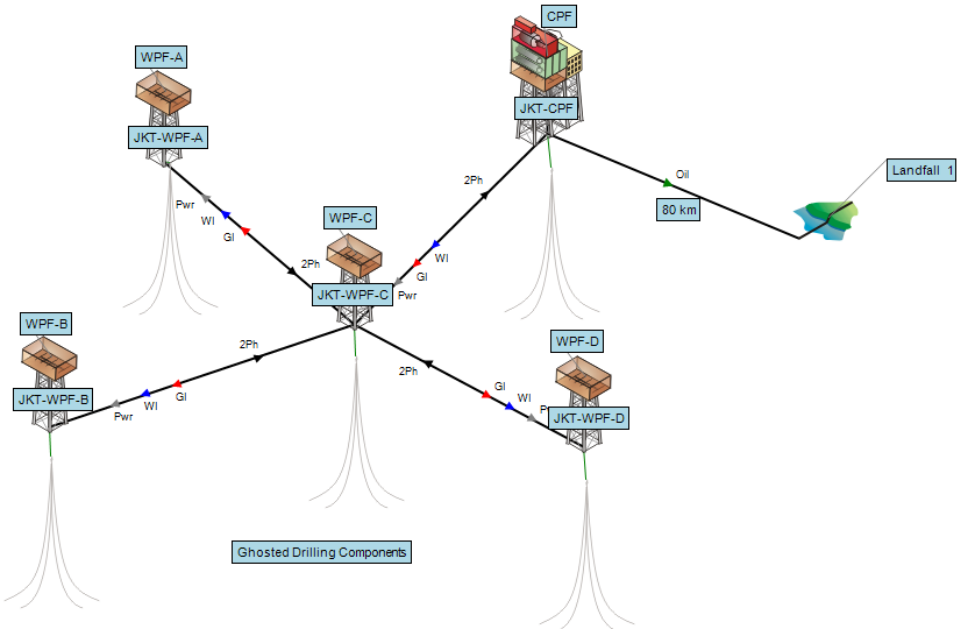
- Save the project

Example 3 – Additional Changes

- Wellhead platform changes
  - Topsides: power generation using microturbines
  - Jacket: Installed by launch
- Central processing platform changes
  - Fully stabilised oil processing
  - Gas compression cooling by fin fan coolers
  - Modular configuration with a module size <6000 te
- OPEX (*Project / OPEX*)
  - Operating personnel cost per man + 10%
  - Production well workover frequency = 6 years
- Scheduling (*Project / Scheduling*)
  - First oil – Month 48
  - Production from Wellhead Platform starts 1 year after first oil
- Investment and Production Profile (*Project / Investment and production profiles*)
  - Export to Excel (*File / Export to Excel workbook...*)

Example 3 – Removing the Drilling Cost

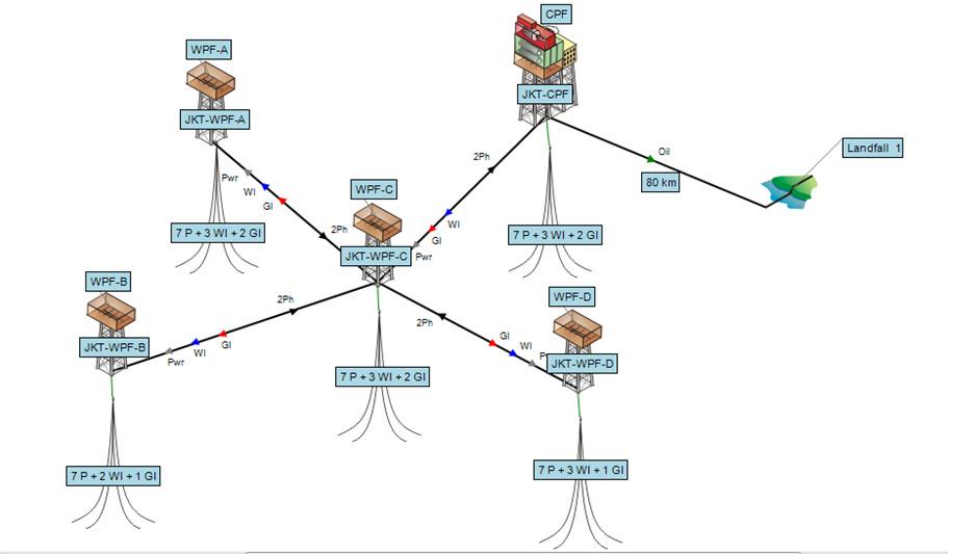
- Remove the CAPEX and OPEX elements of the drilling components
  - Right click on the drilling component and “Ghost” each element
    - Default options can be set (*Options / Ghost options*)



- Save project under a new name
- Re-run OPEX, scheduling and investment profile
  - Export to Excel (*File / Export to Excel workbook...*)

Example 3 – Adding Power Cables

- Double-click the link between the two platforms
- Click ‘Add’ in the power cables section
  - Make sure that the cable is going from the main platform to the wellhead
- Look in the power section of the wellhead platform to check that it has automatically changed to ‘Distribution only’
  - The power requirement of the main platform will also increase
- Save project under a new name



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Example 4 – Brazil

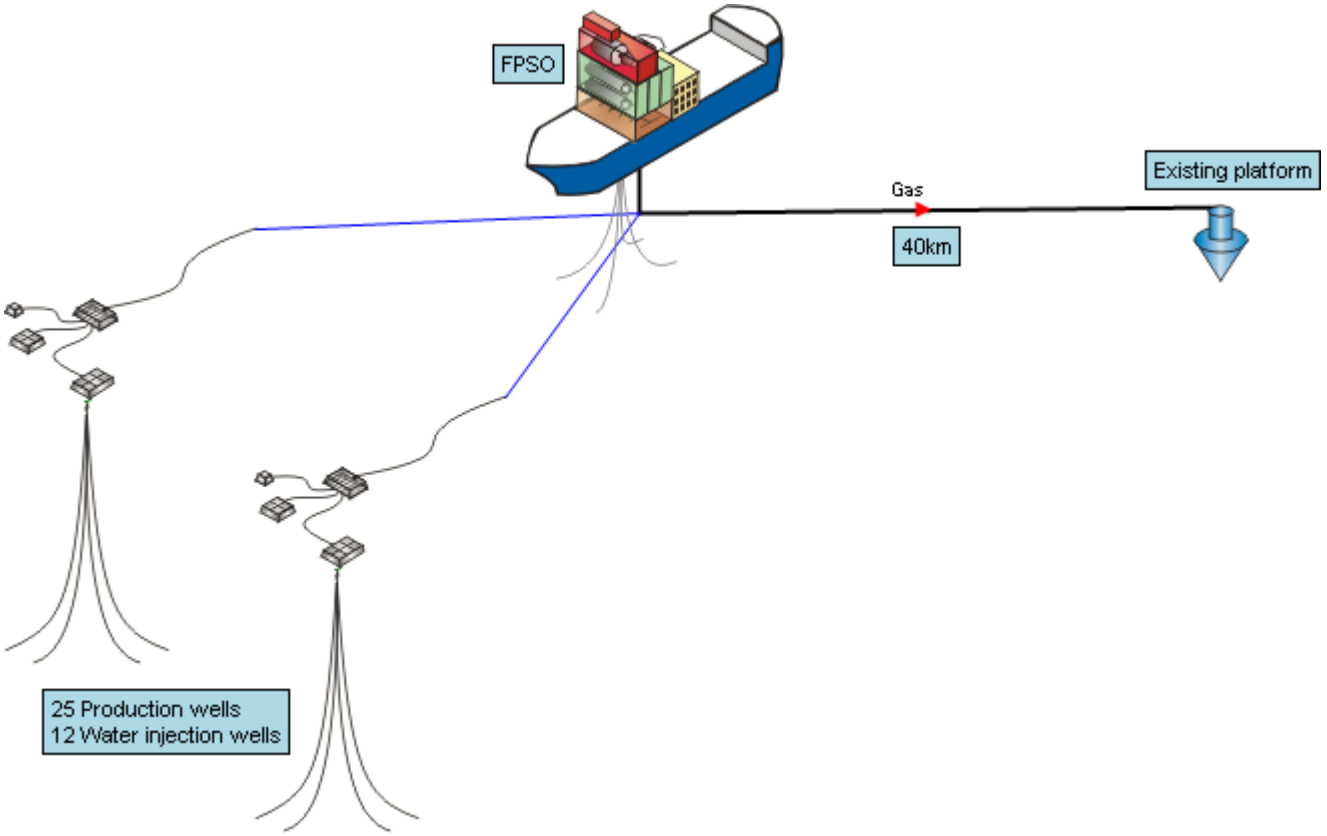
Subsea

Example 4 – Prospect Data

- Input parameters **(Use default if not listed below)**
  - Oil field
  - Latin America / Brazil / Campos Basin
  - Procurement strategy – Brazil (US $)
- Field level data
  - Recoverable reserves = 600 MMbbl (Oil)
  - Gas oil ratio = 500 scf/bbl
  - Reservoir depth = 4500 m
  - Reservoir pressure = 8000 psia
  - Reservoir length = 14 km
  - Reservoir width = 5km
  - Water depth = 800 m
  - Oil density = 20 °API
  - Distance to operations base = 160 km
- Production data
  - Field life = 22 years
  - Plateau rate = 150 Mbbl/day
  - No gas injection
  - Production wells = 25
  - Water injection wells = 12

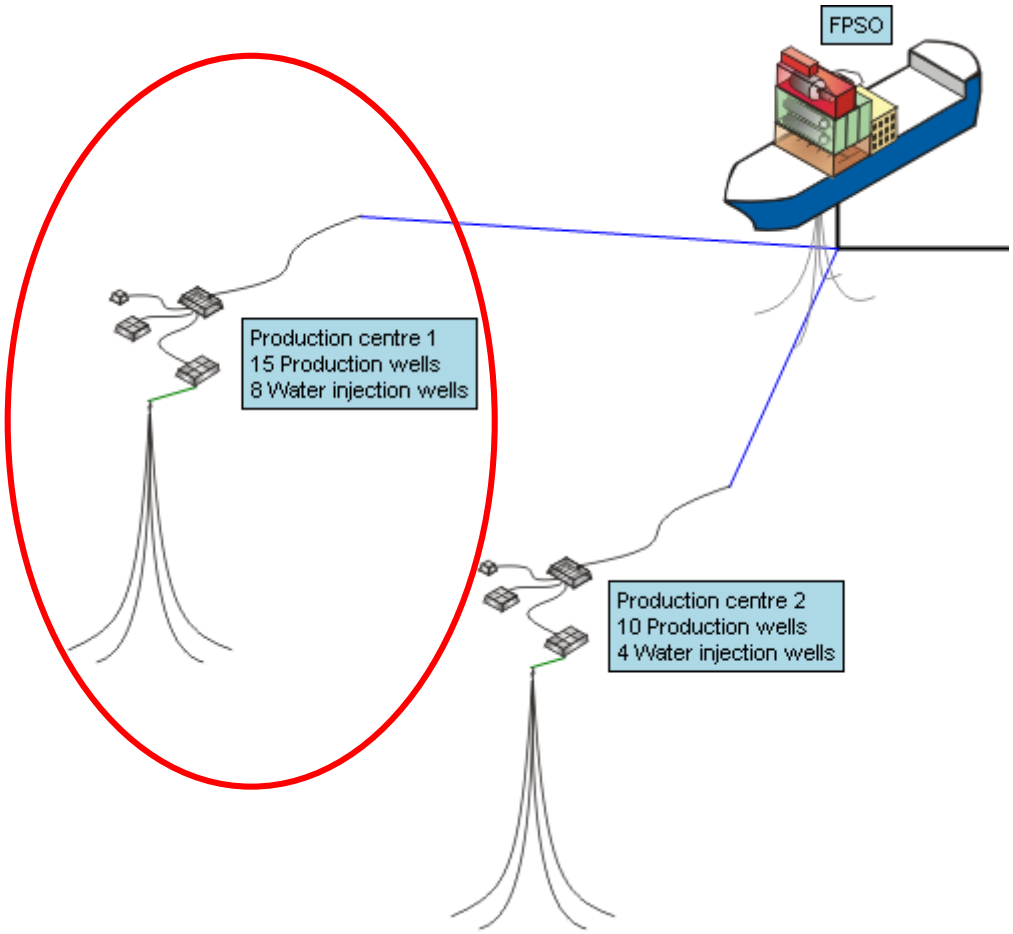
Example 4 – Field Development Schematic

- Development concept – FPSO + Subsea tie back
  - Oil export – Ship to ship
  - Gas export – via existing production platform (40 km)

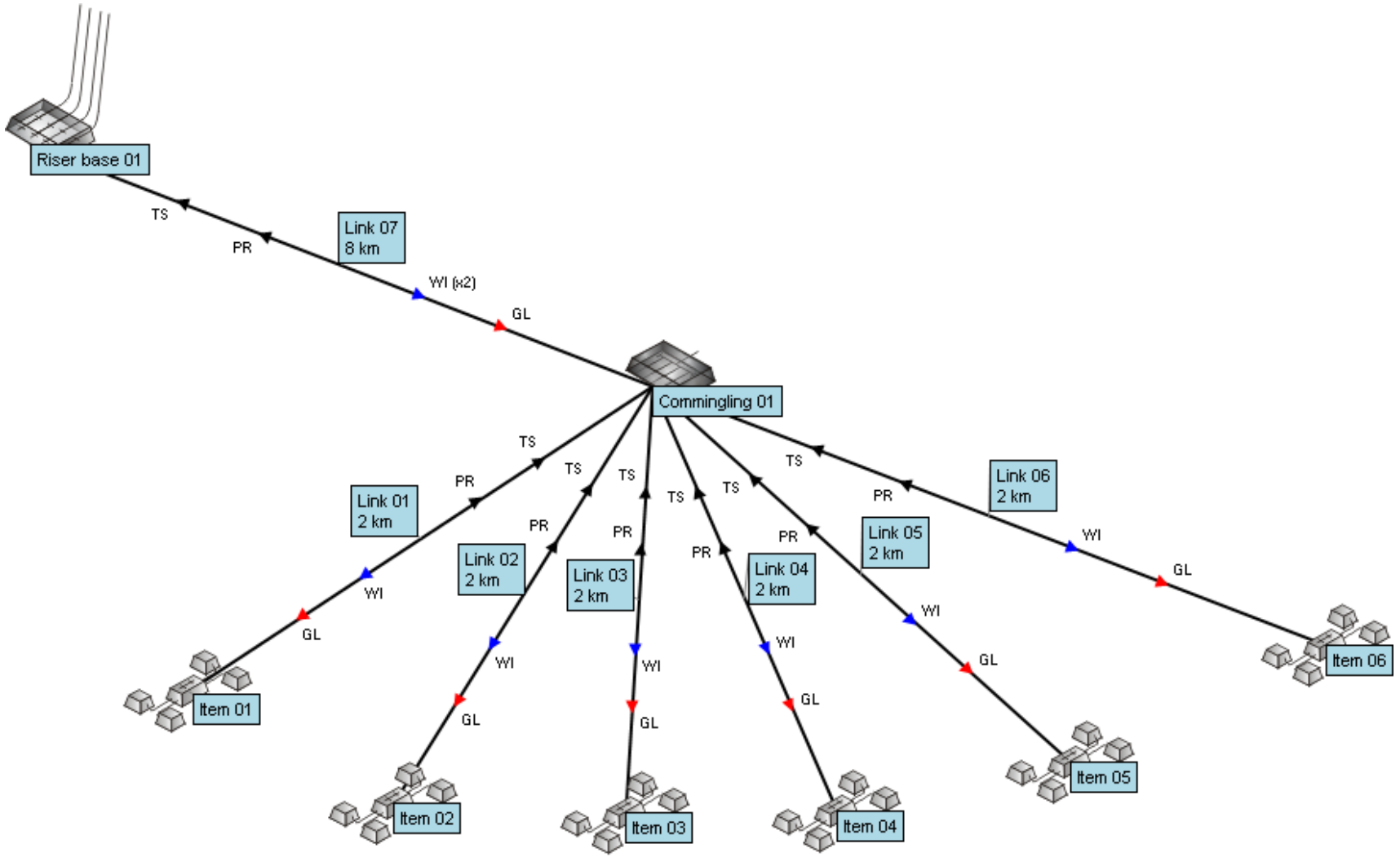


Example 4 – Production Centre 1

- Drilling
  - 15 Production wells
  - 8 Water injection wells
- Subsea
  - 1 spare slot
  - Gas lifted wells
  - Infield flowline length = 2 km
  - Tie-back length = 8 km
  - Soil conditions = Poor
  - Insulated production and test lines
    - Insulation material = PIP – Aerogel
    - Insulation U value = 1 W/m2.C

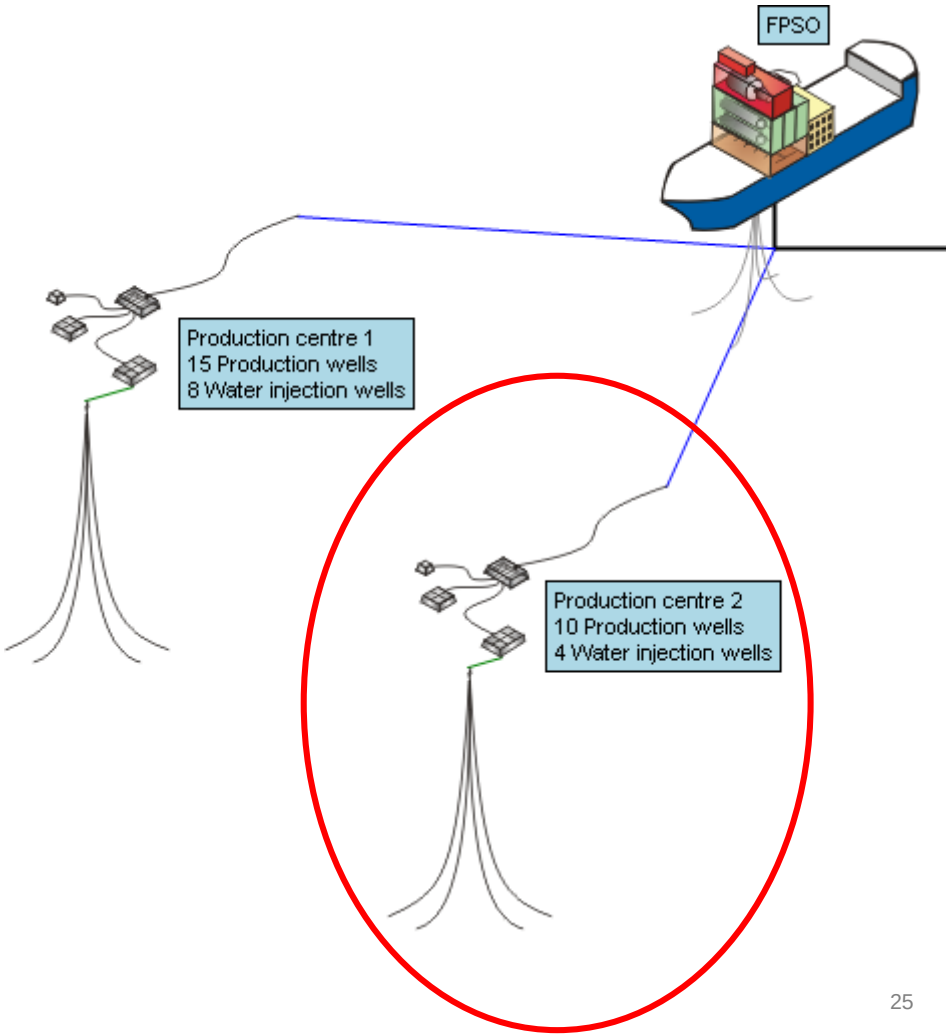


Example 4 – Centre 1: Subsea Schematic

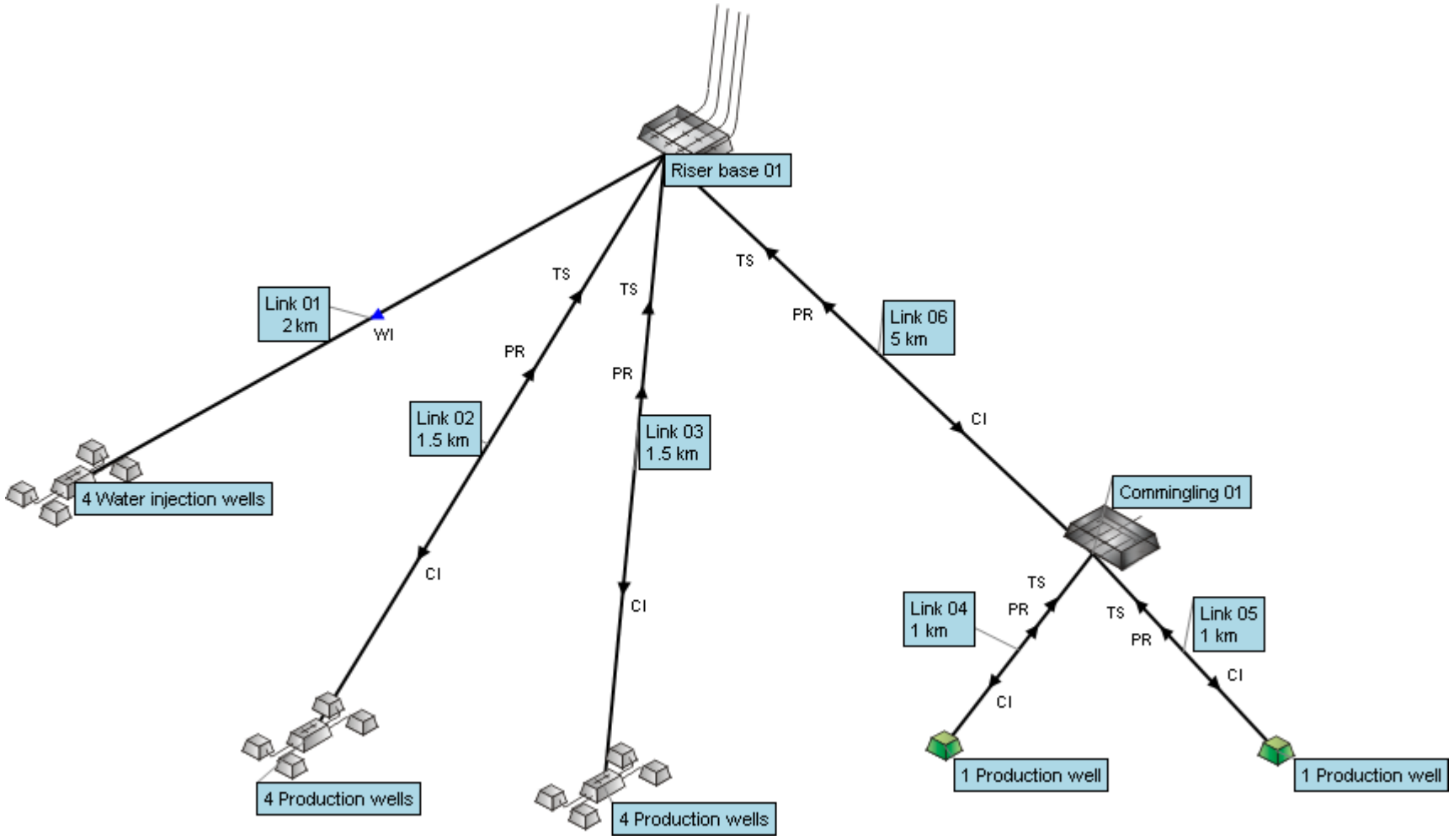


Example 4 – Production Centre 2

- Drilling
  - 10 Production wells
  - 4 Water injection wells
- Subsea
  - Chemical injection
  - Through pigging
  - Water injection cluster (1 x 4 well)
    - Tied-back 2 km to the riser base.
  - Production clusters (2 x 4 well)
    - Tied-back 1.5 km to the riser base
  - 2 production satellites
    - Tied-back 1 km to a manifold
      - Tied-back 5 km to the riser base



Example 4 – Centre 2: Subsea Schematic



Example 4 – Additional Changes

- Drilling
  - All wells drilled using 5000 ft floating drilling rig
- Topsides
  - No integration of existing tanker systems
  - Test separator required
  - Add a Sulphate removal membrane package as a custom equipment item
    - Weight = 500 te
    - Unit rate = $50000/te (Total cost $25 million)
    - Treat as “Package” for bulks and operating weight
    - Power requirement = 2 MW
- Project costs (*Options / Project costs*)
  - Pre-sanction: Add Feed study cost of $5 million
  - Post-sanction: Add Variable owner’s costs of 10% of project CAPEX
- Decommissioning (*Options / Offshore decommissioning*)
  - Set topsides and tanker components to 20% for all cost centres and ignore scrap steel
  - Schedule decommissioning over 24 months
- Export to Excel (*File / Export to Excel workbook...*)
  - Project summary, Field schematic, Cost summary and Investment profile

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Example 5 – Kuwait

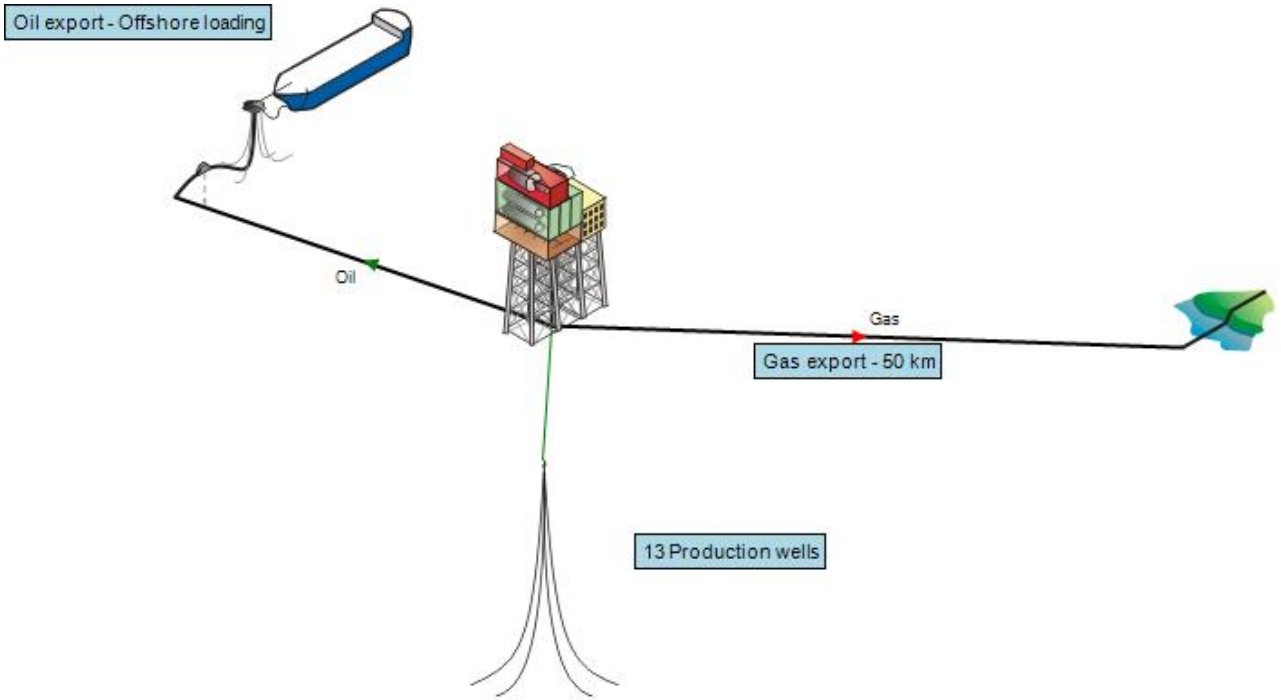
Bridge Linked Development

Example 5 – Prospect Data

- Input parameters **(Use Default if not listed below)**
  - Gas field
  - Middle East / Kuwait/ Arabian Basin
  - Procurement Strategy – Kuwait(US $)
- Field level data
  - Recoverable reserves = 1 Tscf (Gas)
  - Condensate gas ratio = 75 bbl/MMscf
  - Reservoir depth = 2500 m
  - Water depth = 25 m
  - Peak well flow = 20 MMscf/day
  - Distance to operation base = 65 km
  - Distance to delivery point = 50 km
- Production data
  - Field life = 20 years
  - Plateau rate = 250 MMscf/day
  - Swing factor = 1.1

Example 5 – Field Development Schematic

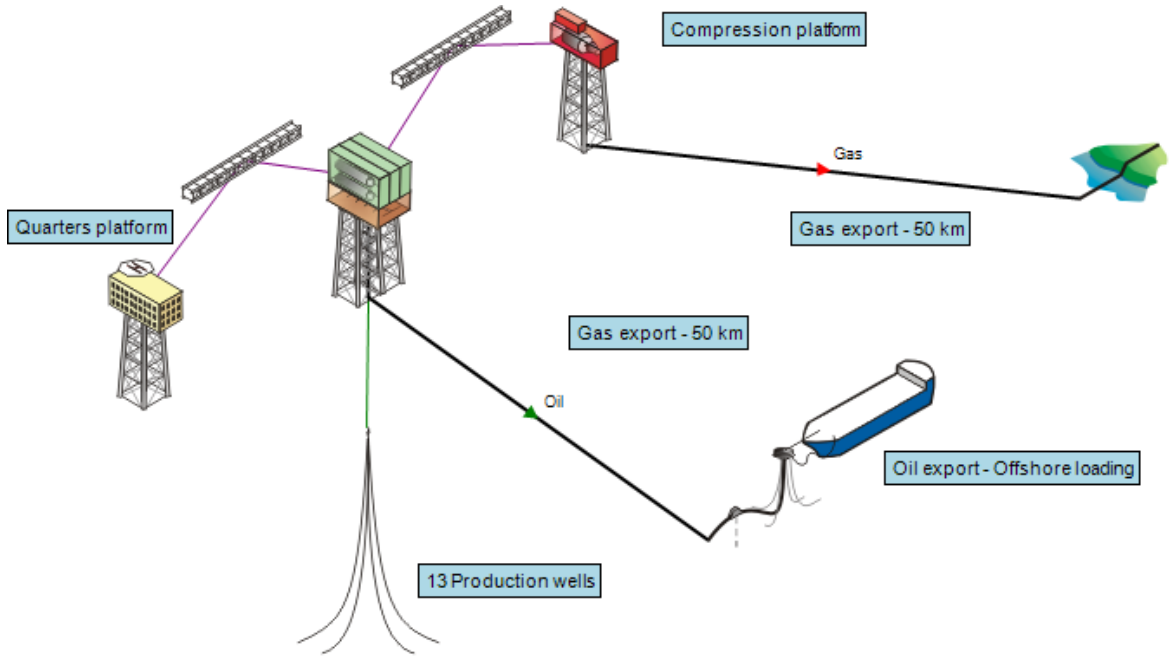
- Development concept – Production platform
  - Gas export – pipeline to shore (90 km)
  - Condensate export – Offshore loading (1 km)



- Save this project for future reference
  - Facilities sizing will assist design of bridge-linked project

Example 5 – Splitting the Facilities

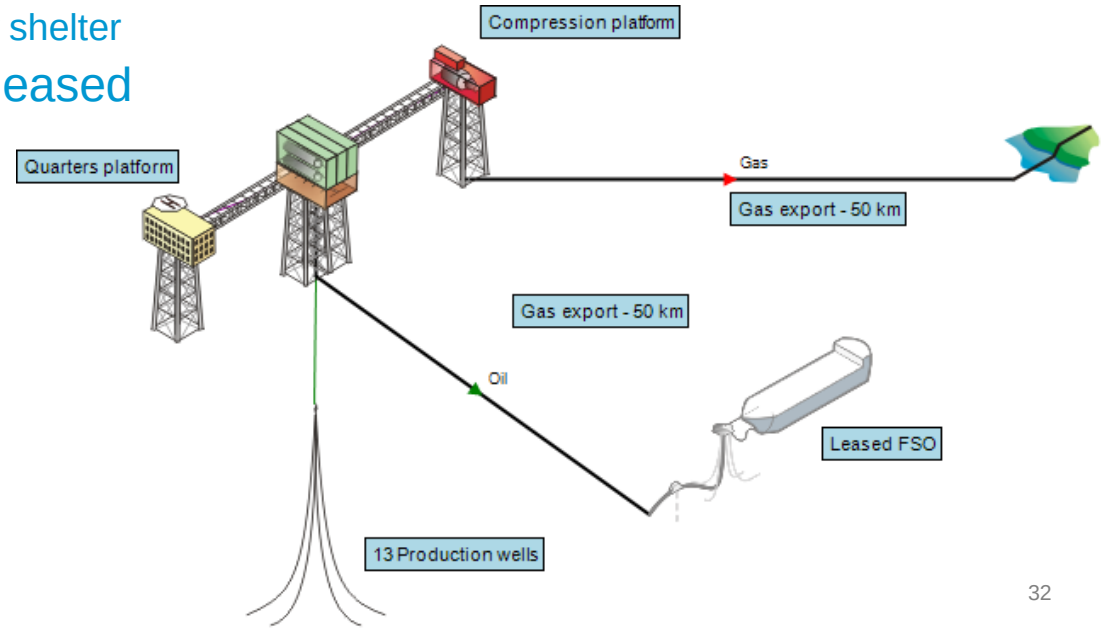
- Split the facilities between 3 platforms
  - Quarters platform – 4 leg jacket
  - Wellhead / Processing / Drilling platform – 6 leg jacket
  - Gas compression platform – 4 leg jacket



- Add bridge links between topsides and connect using link
  - Quarters platform to main processing platform
  - Main processing platform to gas compression platform

Example 5 – Splitting the Facilities

- Quarters topsides
  - Bridge to platform – 50 m triangular bridge with utilities function only
  - Transfer manning requirements to quarters platform (Use saved project as reference)
- Processing topsides
  - Remove helideck and emergency shelter
- Gas compression topsides
  - Bridge to platform – 75 m square bridge with all functions selected
  - Add a gas pipeline to the bridge
  - Make sure that “Pipeline to shore” is selected for the gas export option
  - Remove helideck and emergency shelter
- Offshore loading (FSO) to be leased
  - “Ghost” CAPEX and OPEX
  - Lease rate will be added later



Example 5 – Additional Changes

- Central processing topsides
  - Add custom equipment item for chemical injection module
    - Weight = 250 te
    - Unit rate = $20000/te (Total cost $5 million)
    - Treat as “Package” for bulks and operating weight
    - Heating medium = 1.5 MW
    - Power requirement = 3 MW
- Contingency (*Options / Contingency options*)
  - Fixed contingency set to 30%
- OPEX
  - Decrease operating personnel by 5 from year five until the end of the field life
  - Oil export tariff (shuttle tankers) = 2 $/bbl
  - Lease rate for FSO = $25 million/year
- Scheduling
  - Project start date – July 2015
- Investment and Production Profile
  - Export to Excel

QUE$TOR Offshore

Example 6 – UK North Sea Graben system
Subsea tie-back

Example 6 – Prospect Data

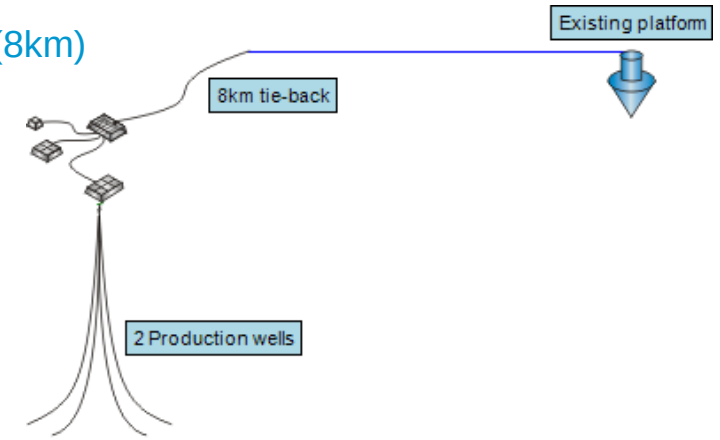
- Input parameters **(Use Default if not listed below)**
  - Gas field
  - Europe / UK (South) / North Sea Graben System
  - Procurement Strategy – UK South (US $)
- Field level data
  - Recoverable reserves = 80 Bscf (Gas)
  - Reservoir depth = 3000 m
  - Reservoir pressure = 450 bar
  - Reservoir length = 3 km
  - Reservoir width = 2 km
  - Water depth = 115 m
  - CO_2 content = 5%
  - H_2S content = 15 ppm
  - Well productivity = 40 Bscf/well
  - Distance to operations base = 150 km
  - Distance to delivery point = 8 km

Example 6 – Prospect Data

- Production data
  - Field life = 5 years
  - Set daily production as per values below:

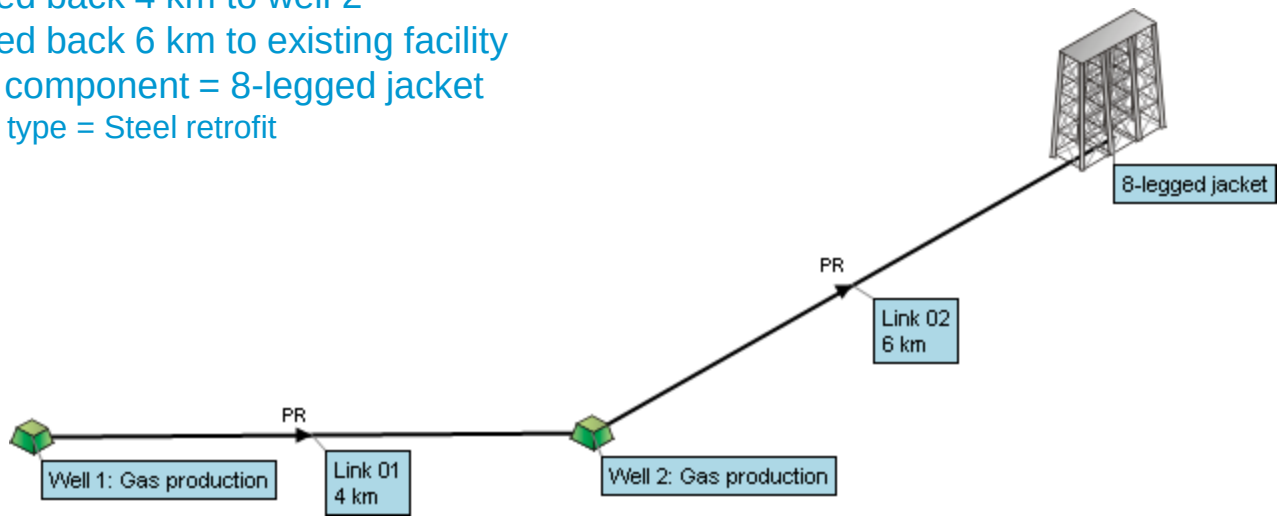
Production	Units	Year 1	Year 2	Year 3	Year 4	Year 5
Gas	MMscf/day	40	65	65	40	19.5
Condensate	Mbbl/day	7	12	10	7	5
Water	Mbbl/day	0.07	0.12	0.1	0.07	0.05

- Number of wells
  - Production = 2
- Concept – Subsea tie-back
  - Gas export - via existing production platform (8km)



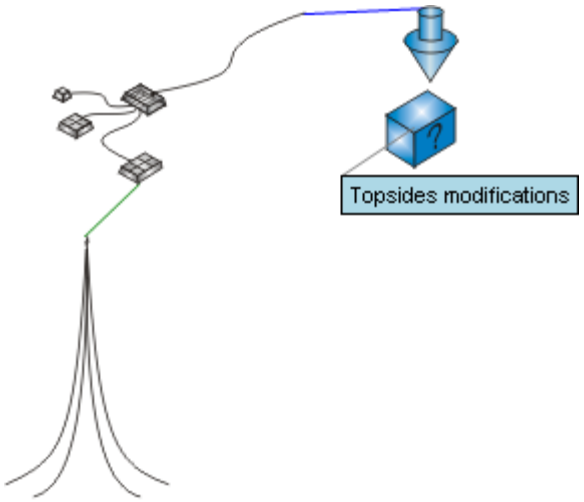
Example 6 – Drilling and subsea

- Drilling
  - Both wells are vertical, drilled with a 3000 ft floating drill rig
- Subsea
  - Production flowline material = Clad 316 stainless
  - Mob / demob for laybarge = 10 days
- Subsea schematic
  - The wells will be set up in a “Daisy chained” configuration
  - Well 1: tied back 4 km to well 2
  - Well 2: tied back 6 km to existing facility
  - Tie-back component = 8-legged jacket
    - Riser type = Steel retrofit



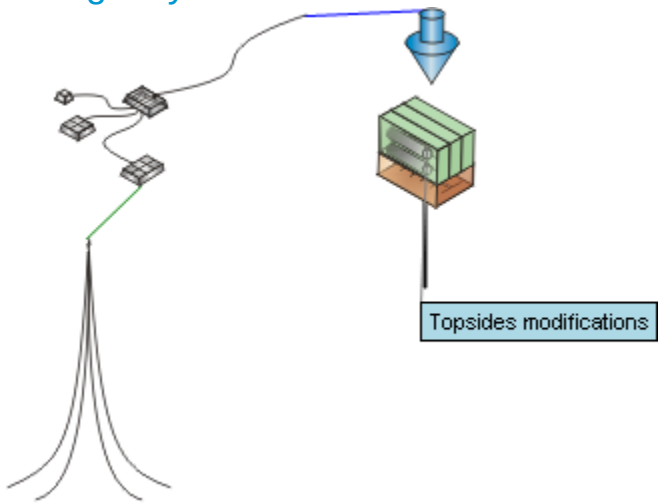
Example 6 – Topsides modifications

- Option 1: User defined component
  - Equipment = $5 million
  - Materials = $3 million
  - Fabrication = $2.5million
  - Installation = $1.5 million
  - Design and PM
    - Design = 9000 mhr
    - PM = 800 mhr
  - Contingency = 30%



- Save the user defined component

- Option 2: Modified topsides
  - Equipment (Acid gas)
    - Manifolding = 10t e
    - Separator = 45 te
  - Materials and fabrication
    - Secondary steel = 50 te
    - Piping = 26 te
    - Electrical = 5 te
    - Instruments = 15 te
    - Others = 10 te
  - Installation
    - Installation spread = 10 days (for <2500 te modules)
    - Offshore HUC= 2000 hr
  - Design and PM
    - Design = 9000 mhr
    - PM = 800 mhr
  - Contingency = 30%



Example 6 – Topsides modifications

- OPEX
  - Remove well workover cost for both production wells
  - Field / project logistics costs allocated 50% share for this project
  - Gas transportation tariff paid = $0.5/Mscf
- Scheduling
  - First gas = Month 36
- Investment and production profile
  - Export to Excel
- Input these values into “Example6.xls” spreadsheet
  - Copy total CAPEX, OPEX and Decommissioning expenditure
  - Copy gas and condensate production into the cells
  - Product sales prices can be adjusted as required
  - Tax rate and discount rate can be adjusted as required

QUE$TOR Offshore

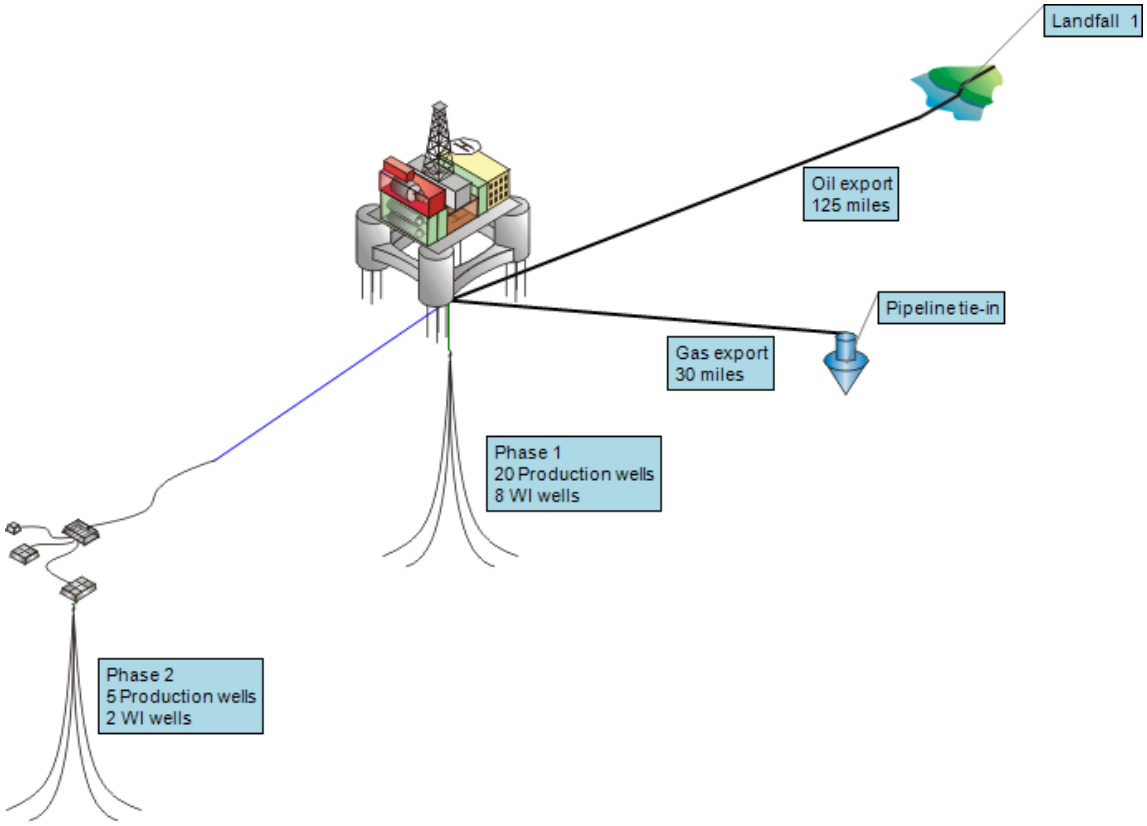
Example 7 – Deepwater Gulf of Mexico
Phased Drilling

Example 7 – Prospect Data

- Input parameters **(Use default if not listed below)**
  - Oil field
  - North America / United States / Deep Water Gulf of Mexico basin
  - Procurement strategy – Gulf of Mexico (US $)
- Field level data
  - Recoverable reserves = 400 MMbbl (Oil)
  - Gas oil ratio = 500 scf/bbl
  - Reservoir depth = 4000 m
  - Reservoir pressure = 550 bar
  - Water depth = 1400 m
  - Oil density = 30 °API
  - CO_2 content = 2%
  - Distance to operations base & delivery point = 125 ***miles***
- Production data
  - No gas injection
- Concept – TLP + Subsea tie back
  - Oil to shore (125 miles)
  - Gas to pipeline tie-in (30 miles)

Example 7 – Field Development Schematic

- Wells drilled in 2 phases
  - Phase 1 (Platform): 20 production wells, 8 water injection wells
  - Phase 2 (Subsea): Infill wells, drilled 5 years after 1st oil (Scheduling – Change later)



Example 7 – Manual Changes

- Modify the production profile to fit drilling profile
  - Step 1: Check total drilling time for phase 1 (1038 days/3 years to plateau)
  - Step 2: Lock production rates for drilling and subsea
  - Step 3: Adjust years to plateau (3 years)
  - Step 4: Reduce plateau rate (120 Mbbl/day)
  - Step 5: Adjust topsides capacity (equal to design rates)
- Oil export line to shore 28” (change in topsides or pipeline)
- Gas export line to Y piece in 500m water depth
- Poor soil conditions (Subsea + TLP)
- Subsea wells
  - Semi bare rig charter rate +25%
- OPEX
  - Operating personnel costs +10%
  - No tariffs for gas pipeline tie-in
- Scheduling
  - Adjust drilling as per phased drilling program
- Reports
  - Export project summary, cost summary and investment and production profile to Excel

QUE$TOR Case Studies

Combined (Offshore + Onshore)

QUE$TOR Combined

Example 1 – Indonesia

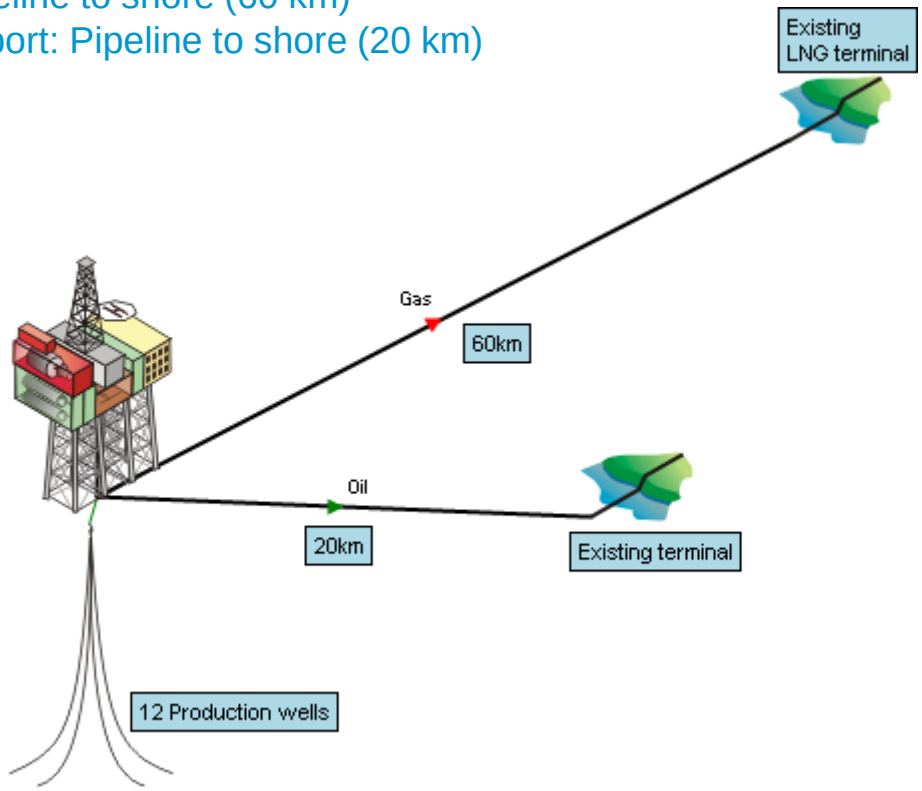
Offshore vs. Onshore Processing

Example 1 – Offshore vs Offshore + Onshore

- Input parameters **(Use default if not listed below)**
  - Gas field
  - Far East / Indonesia / Kutei Basin
  - Procurement strategy – Indonesia
- Field level data
  - Recoverable reserves = 500 Bscf (Gas)
  - Condensate gas ratio = 40 bbl/MMscf
  - Reservoir depth = 2000 m
  - Reservoir pressure = 4500 psia
  - Reservoir length = 4 km
  - Reservoir width = 1.5 km
  - Water depth = 50 m
  - Well productivity = 40000 MMscf/well
  - Peak well flow = 25 MMscf/day
  - Distance to operations base = 70 km
  - Distance to delivery point = 60 km
- Production data
  - Field life = 9 years
  - Years to plateau = 1 year
  - Swing factor = 1.1
  - Production wells = 12

Example 1 – Offshore Processing

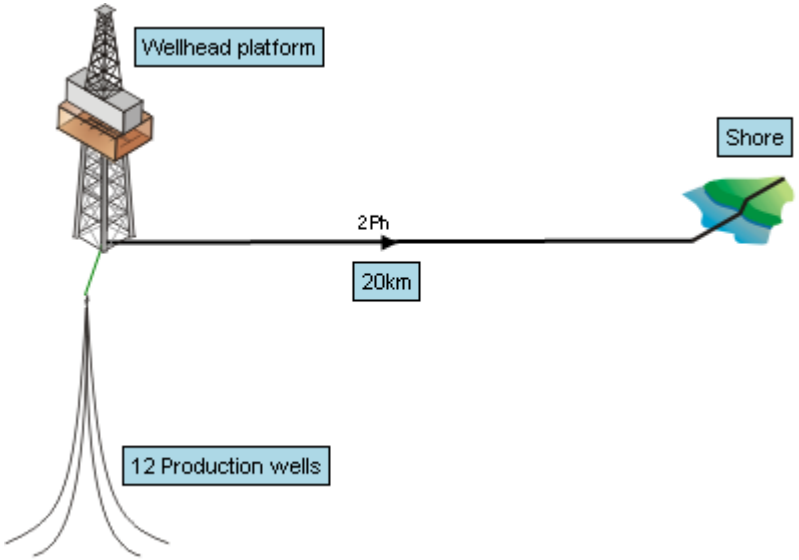
- Concept: Production platform
  - Gas export: Pipeline to shore (60 km)
  - Condensate export: Pipeline to shore (20 km)



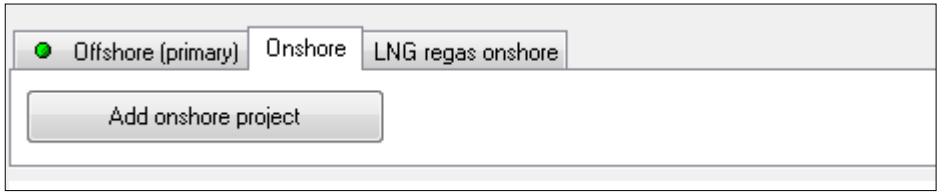
- Save the project

Example 1 – Onshore Processing: Step 1

- Concept: Wellhead platform with tie back
  - Gas export: Pipeline to shore (20 km)

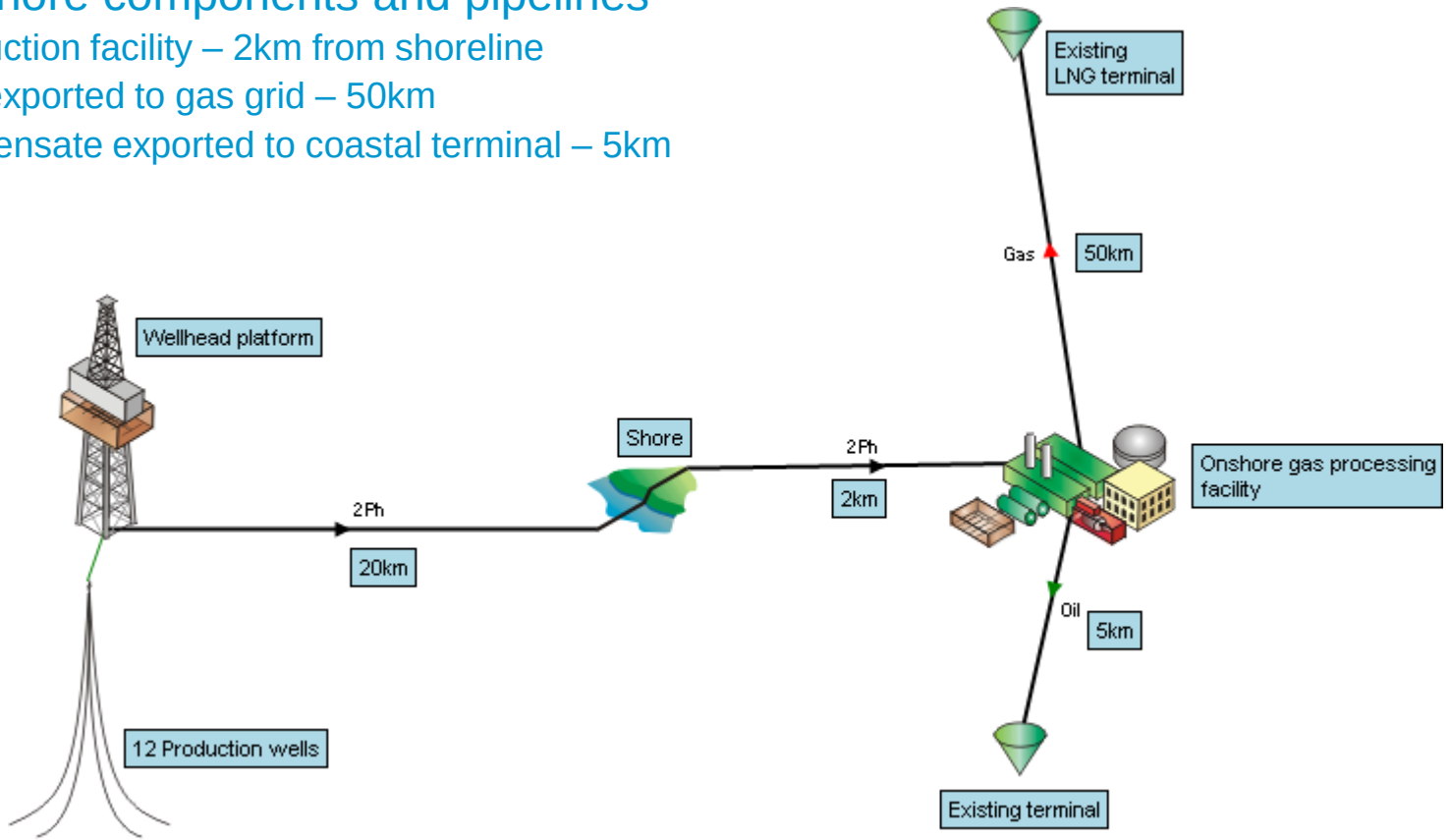


- Add an onshore project
  - Onshore procurement strategy - Indonesia



Example 1 – Onshore Processing: Step 2

- Add onshore components and pipelines
  - Production facility – 2km from shoreline
  - Gas exported to gas grid – 50km
  - Condensate exported to coastal terminal – 5km



- Save the project under a new name (*File / Save as...*)