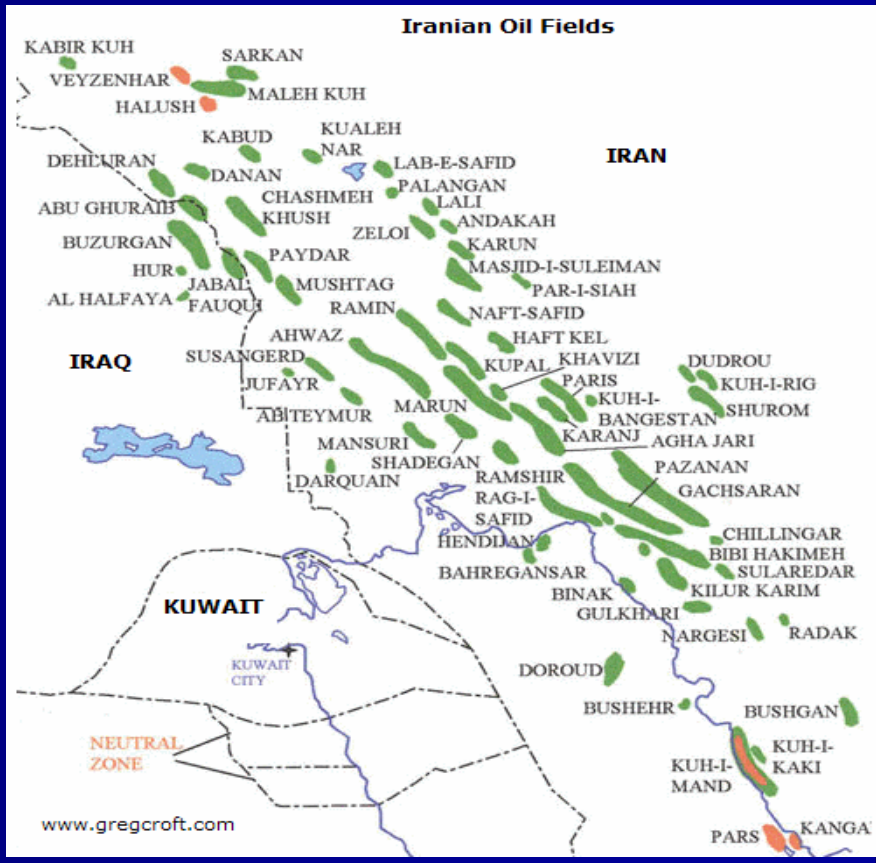
Feasibility Study of Carbon Dioxide Capture from Ramin Power Plants And Injection In Khuzestan Oilfields

Rahbord Energy Alborz

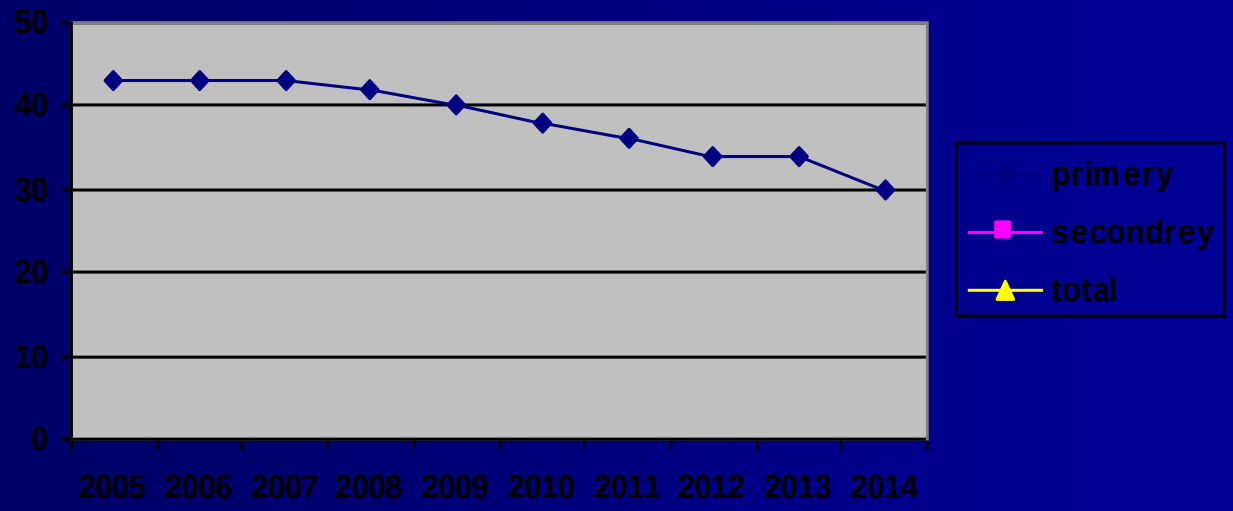
Khuzestan Oilfields

- 30 oil fields
- 47 reservoir



Khuzestan Oilfields

- One of fields production forecast 2005-2015



Khuzestan Oilfields

- Gas injection and pressure maintenance plan:
- Ahvaz bangestan
- Aghajari
- Kupal
- Binak
- Maroon
- Naft sefid
- Bibi Hakimeh

Khuzestan Oilfields

- Gas required:
- 217 MSCMD 2014
- Total: 79.205 BSCM Y 2014
- Total 1355 SBCM Y 2005-2015
- Gas will supply from :North Pars ,South Pars ,Pazanan, Aghar ,Dalan, Sahand ,Ghaleh nar

Khuzestan Main stationary CO_2 Sources

- Power Plants: Ramin, Zargan,Abadan
- Refineries: Abadan
- Petrochemical: BIPC, Razi,…
- Industries: Cement factory, Ahvaz steel company

Ramin Power plant

Ramin Power plant

- Ramin power plant located 25 KM north east of Ahvaz city
- Start of power generation :1979
- Ramin contains 6 unit with 350 MW capacity
- Steam boiler cycle
- 3 stage 1 shaft steam turbine each 350 MW
- Steam pressure:245 Kg/cm2
- Steam Temperature :545 C
- Seam production: 1070 ton/hour
- Wet cooling tower
- Cooling water consumption :36000 M3/hour

Ramin Power plant

- Real capacity:1748 MW
- Efficiency:37.2%
- Total units shut down per year :84
- Capacity factor:65%
- % excess air:100%
- Fuel consumption:
- Each unit:70000 m3/hour natural gas
- 70 m3/hour fuel oil

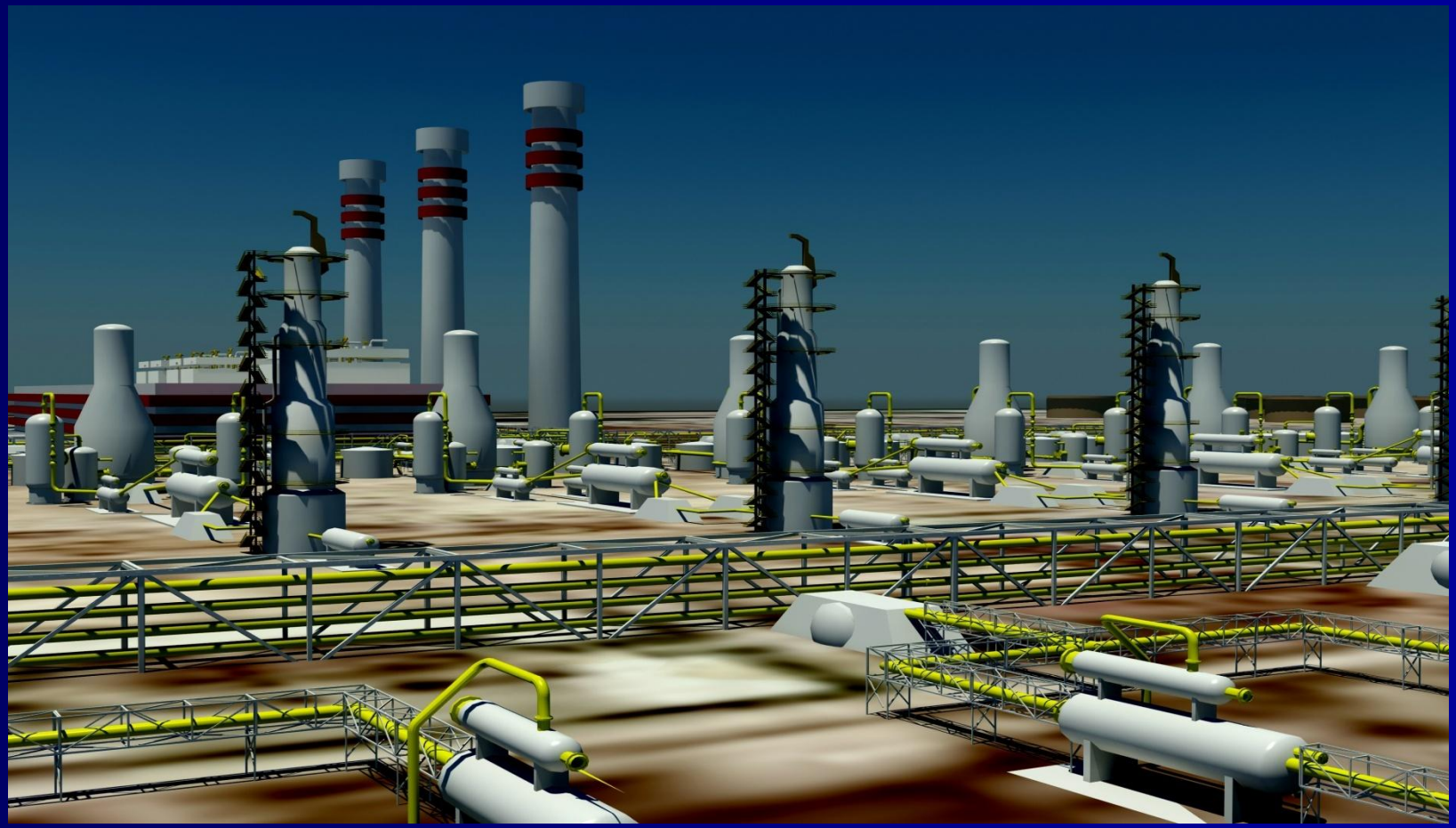
Ramin Power plant

- CO2 production:
- 4793980 ton per year with Natural gas
- 7085471 ton per year with heavy fuel oil
- Flue gas temperature:120-140C
- Total flue gas flow rate:7798000 m3/hour
- Flue gas temperature:4.27 Kg/m2
- Stack :3 stacks

Capturing plant Designing

- Flue gas analysis
- Combustion analysis according to fuel composition
- Feed gas characterization
- Plant conceptual design
- Process basis: Amine cycle
- Obtain data from simulator
- Stream specs setting
- PFD & P&ID
- Equipment sizing

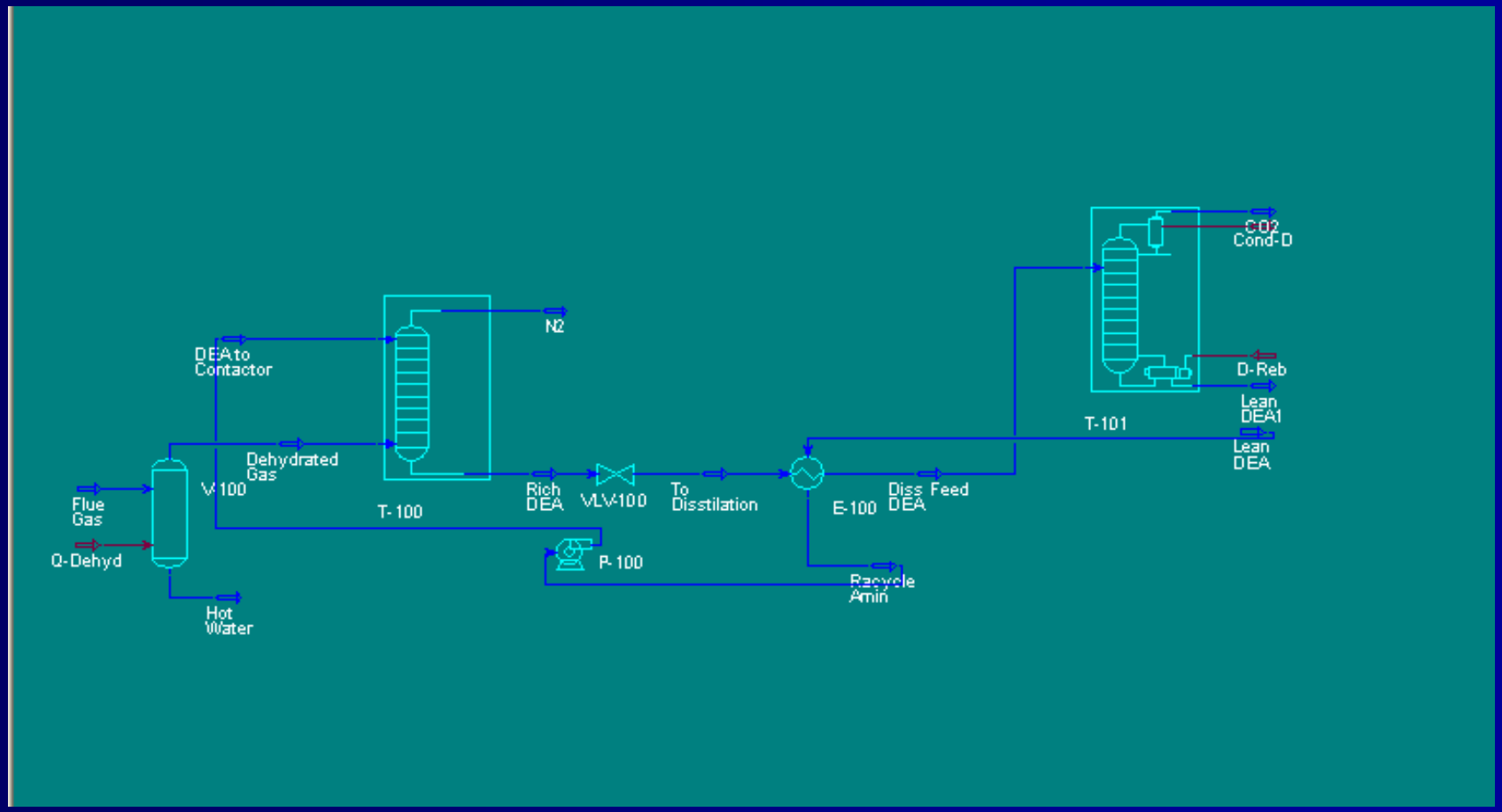
Capturing plant



Process description

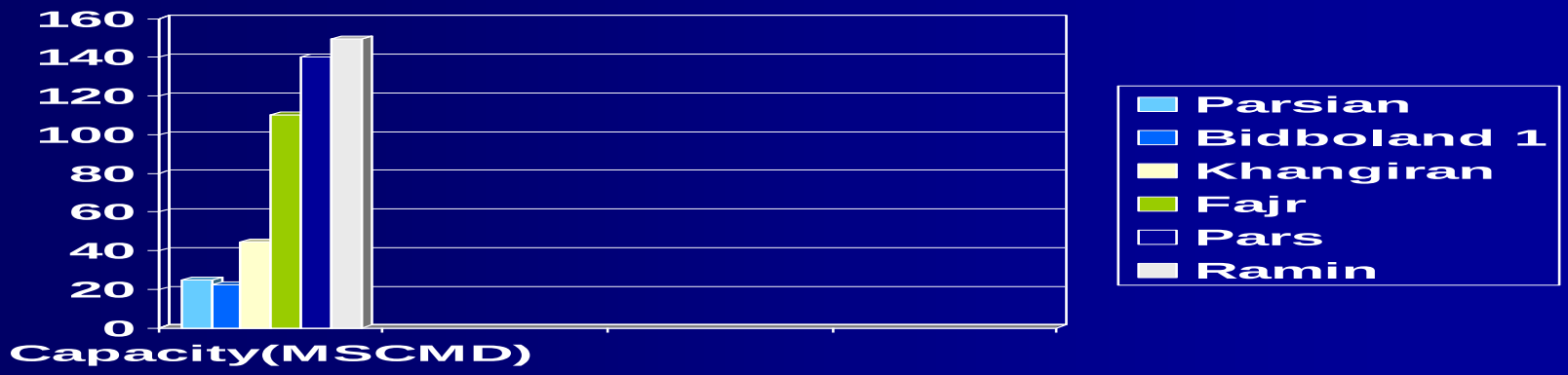
- Use MEA 28% as absorbent
- SO2 washing unit (for fuel oil)
- Flue gas cooler and gas dehydrator
- Absorption column T-100
- Absorption in low Temperature, high Pressure
- Reducing pressure of rich Amine stream
- Amine Regeneration in 90 C, low pressure
- Recycling lean Amine
- Make up water
- Removing NOx (ppm tower)
- CO2 cooling dehydration

Process description



Capturing plant

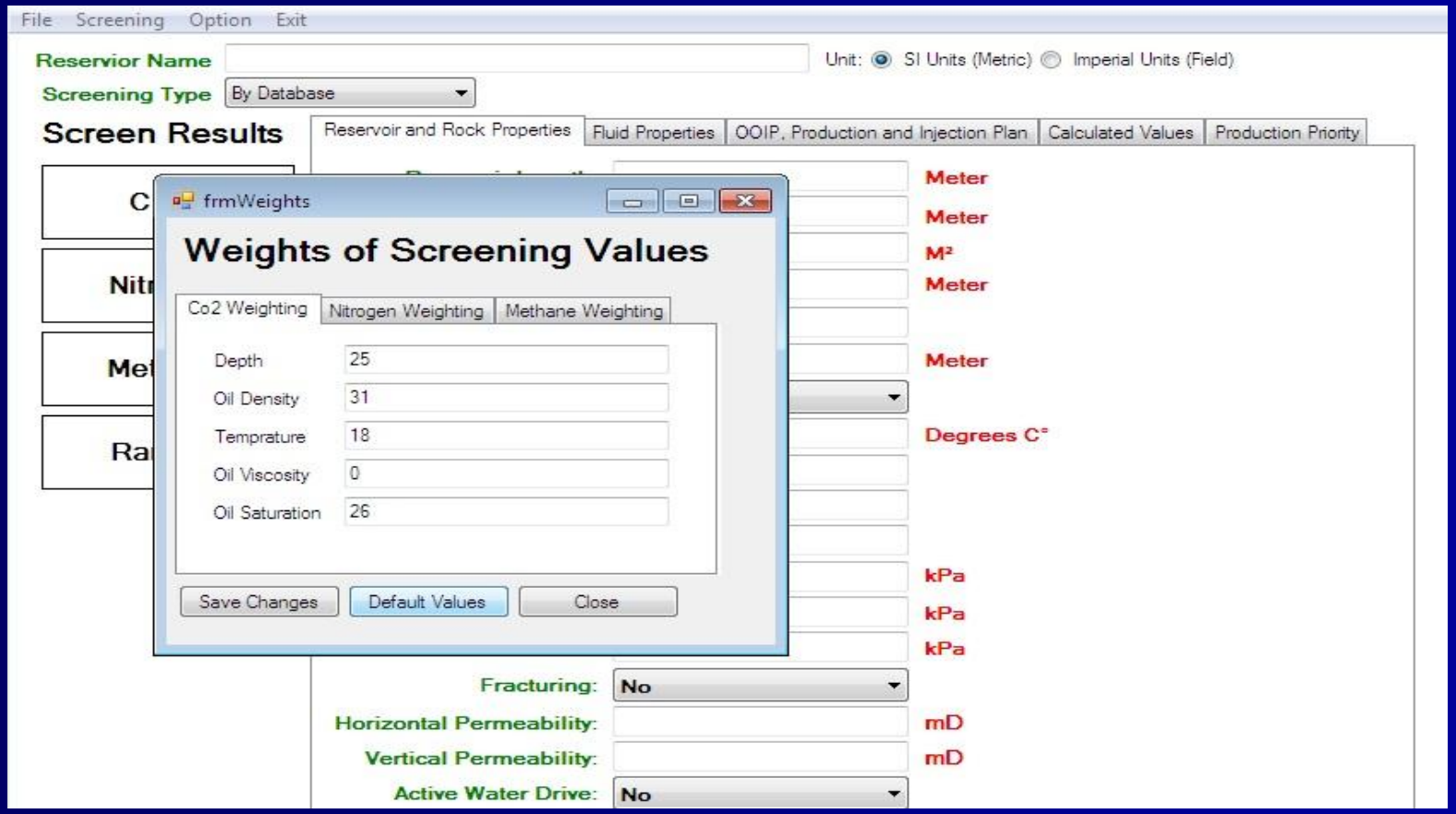
- CO2 flow rate :178.6 Ton/hour
- CO2 purity :more than 98%
- Plant capacity:149.6 M cubic meter day



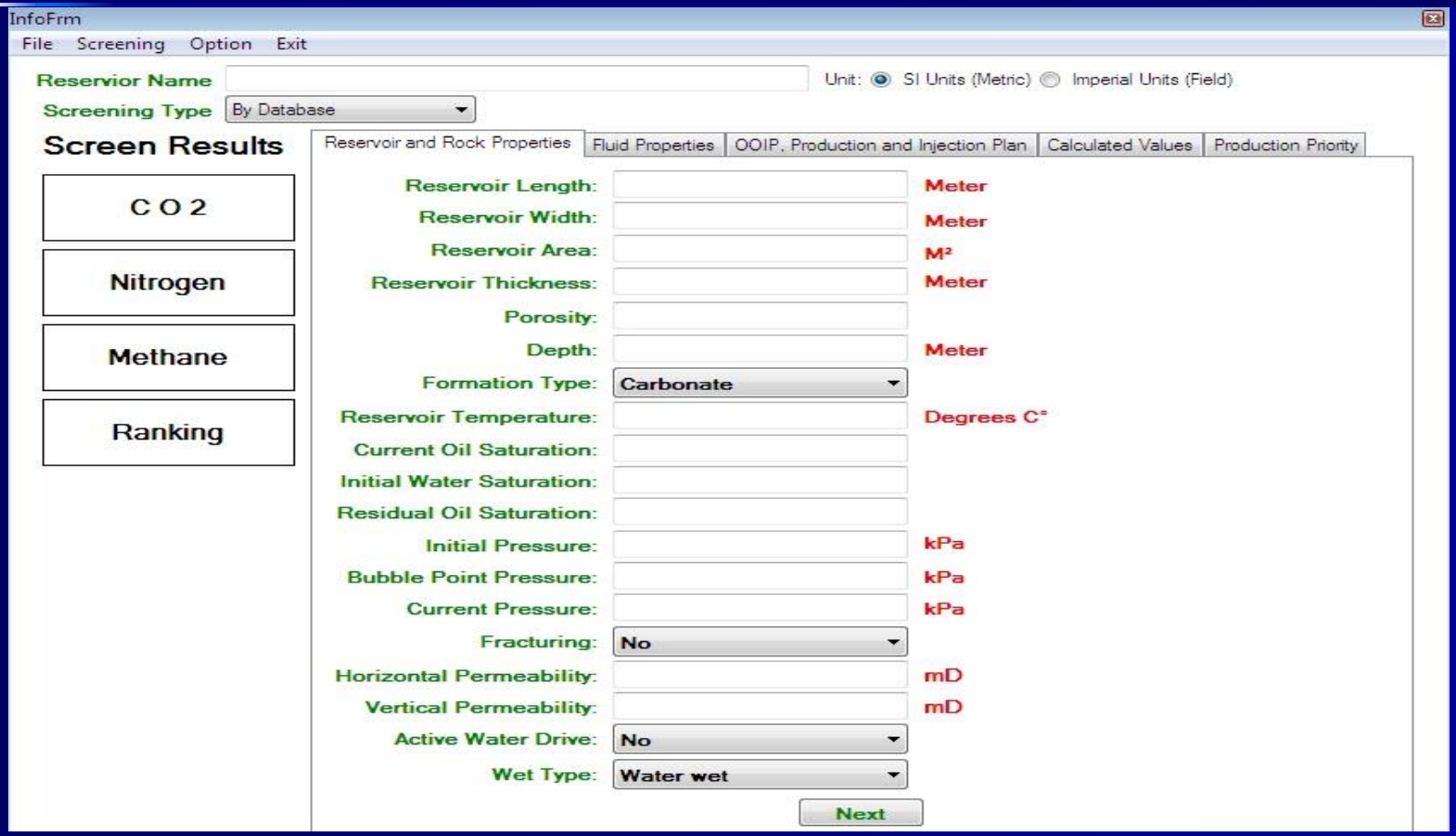
Site Selection

- Criteria:
- Reservoir history
- Reservoir Capacity
- Crude density and viscosity
- Distance from power plant
- Reservoir pressure
- Geology and safe storage

Site Selection: with MEC



Site Selection: with MEC



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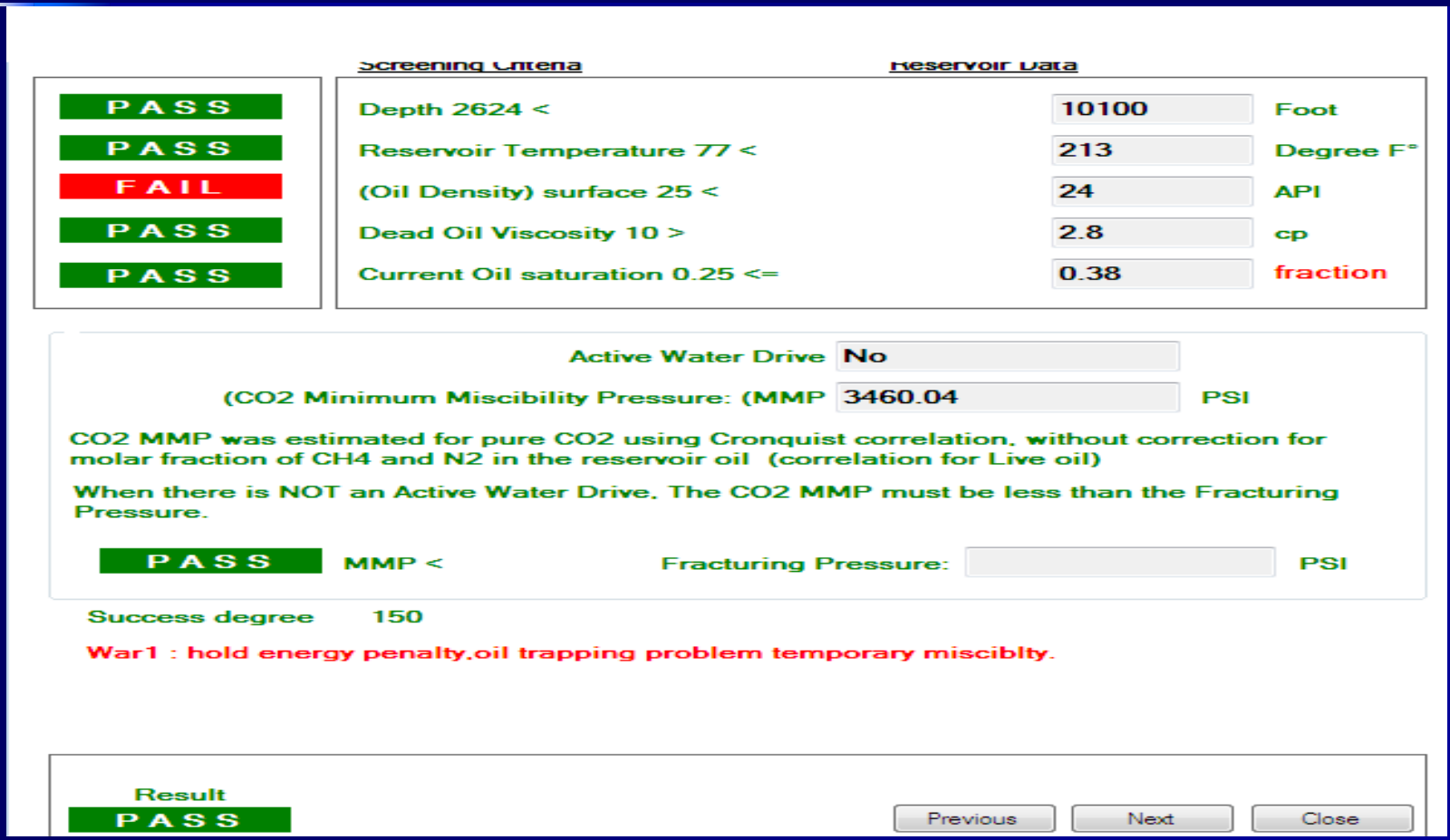


Bangestan

- Major Bangestan Reservoirs are located in vicinity.
- These reservoirs have been explored in the period between 1958 to 1968.
- Production from these filed started on 1971
- Initial pressure of this reservoir was more than 5500 psig
- Porosity:0.14
- Viscosity:1. CP
- API:25.5
- Temperature:220F
- Primary recovery factor:0.11

One of Bangestan Reservoirs

Transfer

- 16 inch carbon steel
- Internal epoxy coating
- Pipe line pressure 90 bar
- Pipe line length:25 KM
- Compressor station: just in start point

Compressor station

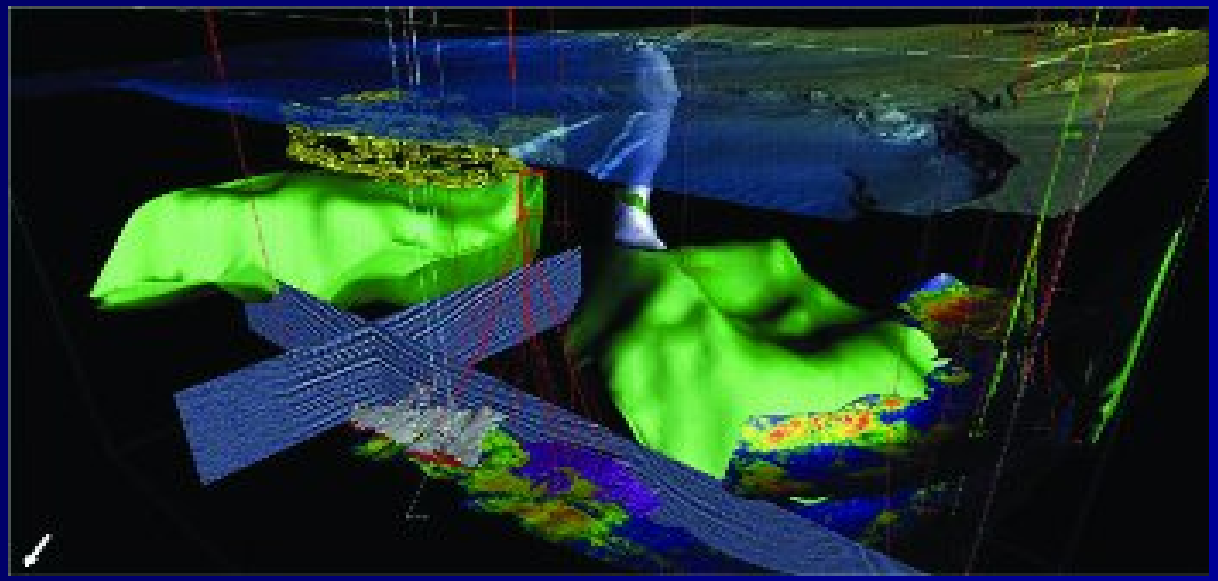
- 1 unit start point of pipeline
- Max pressure :90 bar
- 1 unit in injection site
- Max pressure:387.5 bar
- Total capacity:56.95

Cost estimation

- Capturing plant :920 M$
- Pipe line:75 M$
- Compressor station:150 M$
- Drilling completion & Surface facilities:170 M$
- Total:1248 Million $
- Operating costs:3% per year
- Steam 1400 Tons per hour
- Electrical Power : 392 MW

Oil production

- Increase in production 70000bbl day
- Based on CO2 Injection Simulation



Economic evaluation

- Project economy evaluated in different level of oil price
- Oil prices considered at 28$,35$,45$,55$,70$,85$ per barrel
- Investment recovery estimated In each oil price level

Economic evaluation

- Return time changes between 6.5 years at price 28$/bbl to 1.9 years at price 85$/bbl in low production scenario
- Return time changes between 3.5 years at price 28$/bbl to 1.1 years at price 85$/bbl in high production scenario
- Carbon dioxide avoided cost: 49 $/ton CO2

Economic evaluation

- Economy can be improved by Environmental aids
- CDM facilities can improve economy between 15-30% depend on oil price level

Recommendation:

- More detailed design and feasibility study should be defined about Ramin project to obtain better economical outlook
- Reservoir study should be defined for clear site selection

Thanks for attention

Rahbord Energy Alborz