وزارة البترول والثروة المعدنية
المملكة العربية السعودية

ارامكو السعودية
Saudi Aramco

Global Methane Initiative

CCAC

CAIRN
Energy for India

Global Methane Initiative for Oil and Gas Sector

International Experts Workshops on Carbon Management and its Implications

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Cairn India - An Overview

Rajasthan (RJ-ON-90/1)	
Cairn (Operator)	70%
ONGC	30%

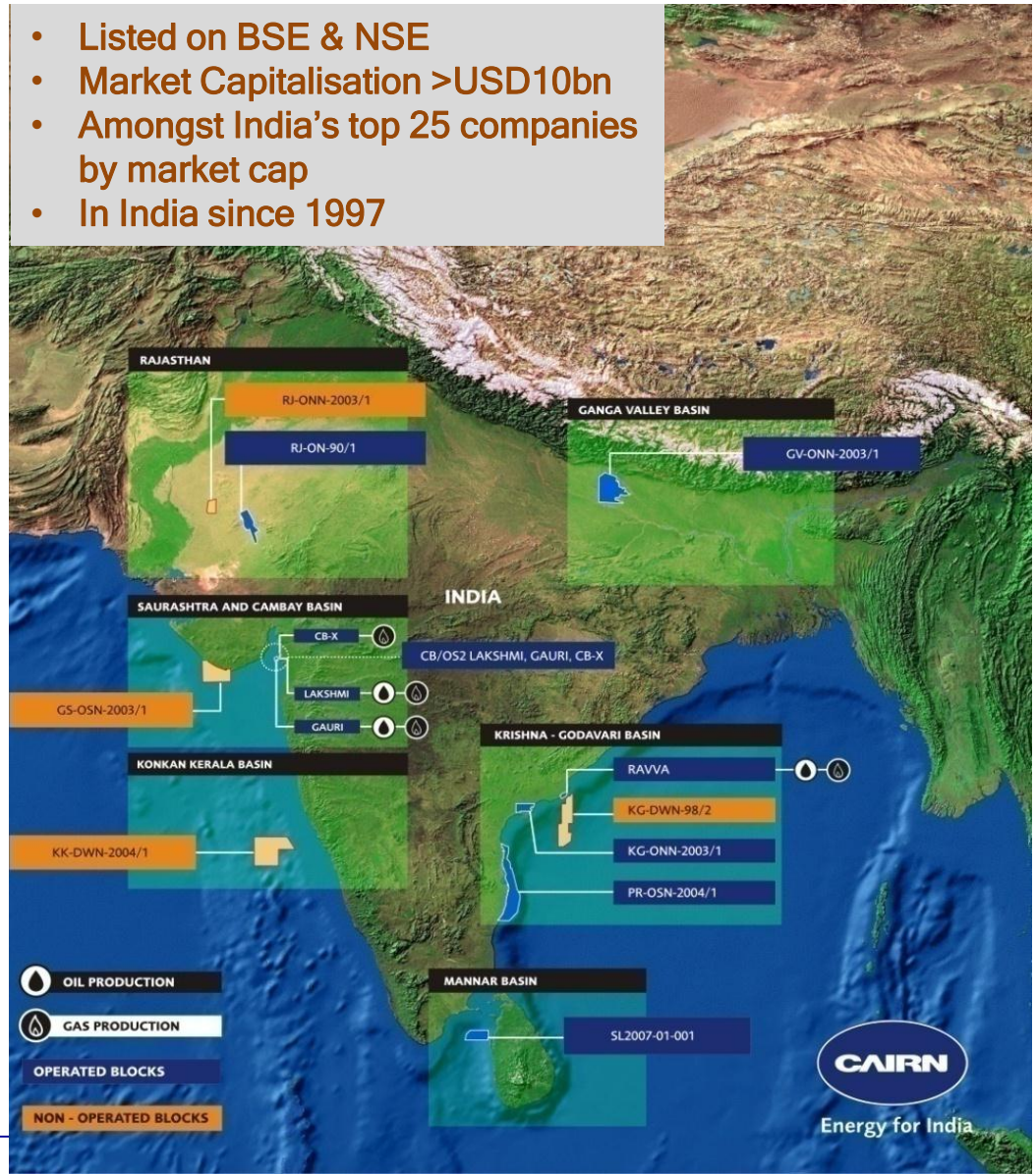
Cambay (CB/OS-2)	
Cairn (Operator)	40%
ONGC	50%

Ravva	
Cairn (Operator)	22.5%
ONGC	40%

Sri Lanka	
Cairn Lanka	100%

South Africa	
Cairn SA	60%
Petro SA	40%

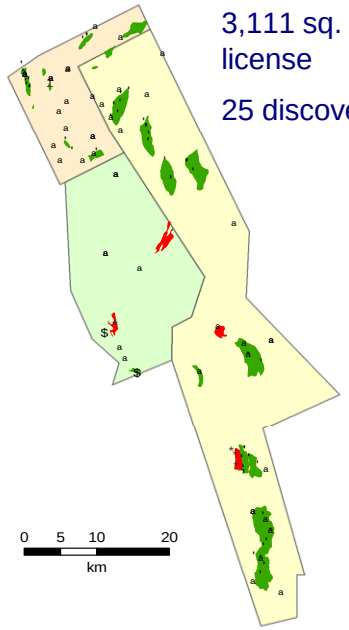
- Listed on BSE & NSE
- Market Capitalisation >USD10bn
- Amongst India's top 25 companies by market cap
- In India since 1997



Rajasthan: Frontier Exploration to Production – The Journey

1997	2002	2002-4	2004	2004-9	2009	2010	2011	2014
Cairn enters PSC	Guda Discovery/ Shell exit	Cairn exploration campaign	Well #15: Mangala Discovery	25 Discoveries 6.5 billion barrel resource identified	First oil from Mangala	World's longest continuously heated & insulated pipeline commissioned	Producing 175,000 bopd	Producing ~200,000 boepd

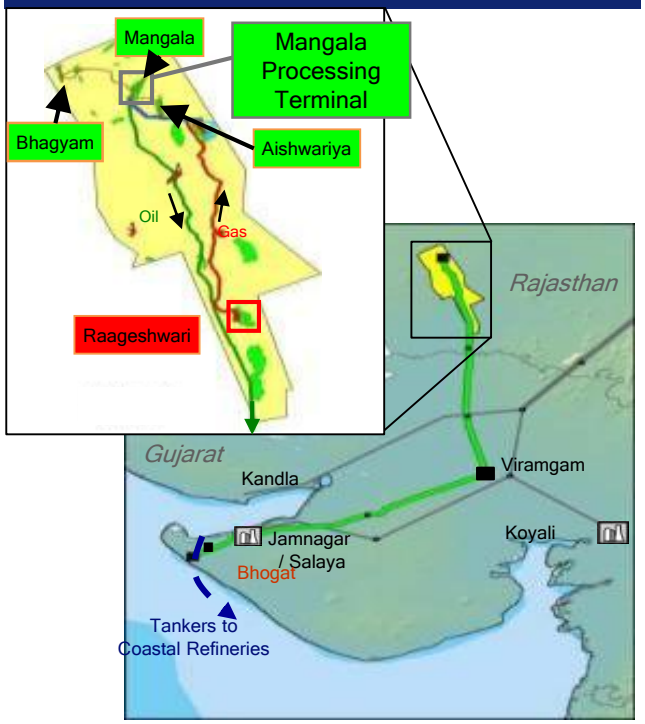
Exploration & Appraisal



3,111 sq. km under license

25 discoveries

Development & Production



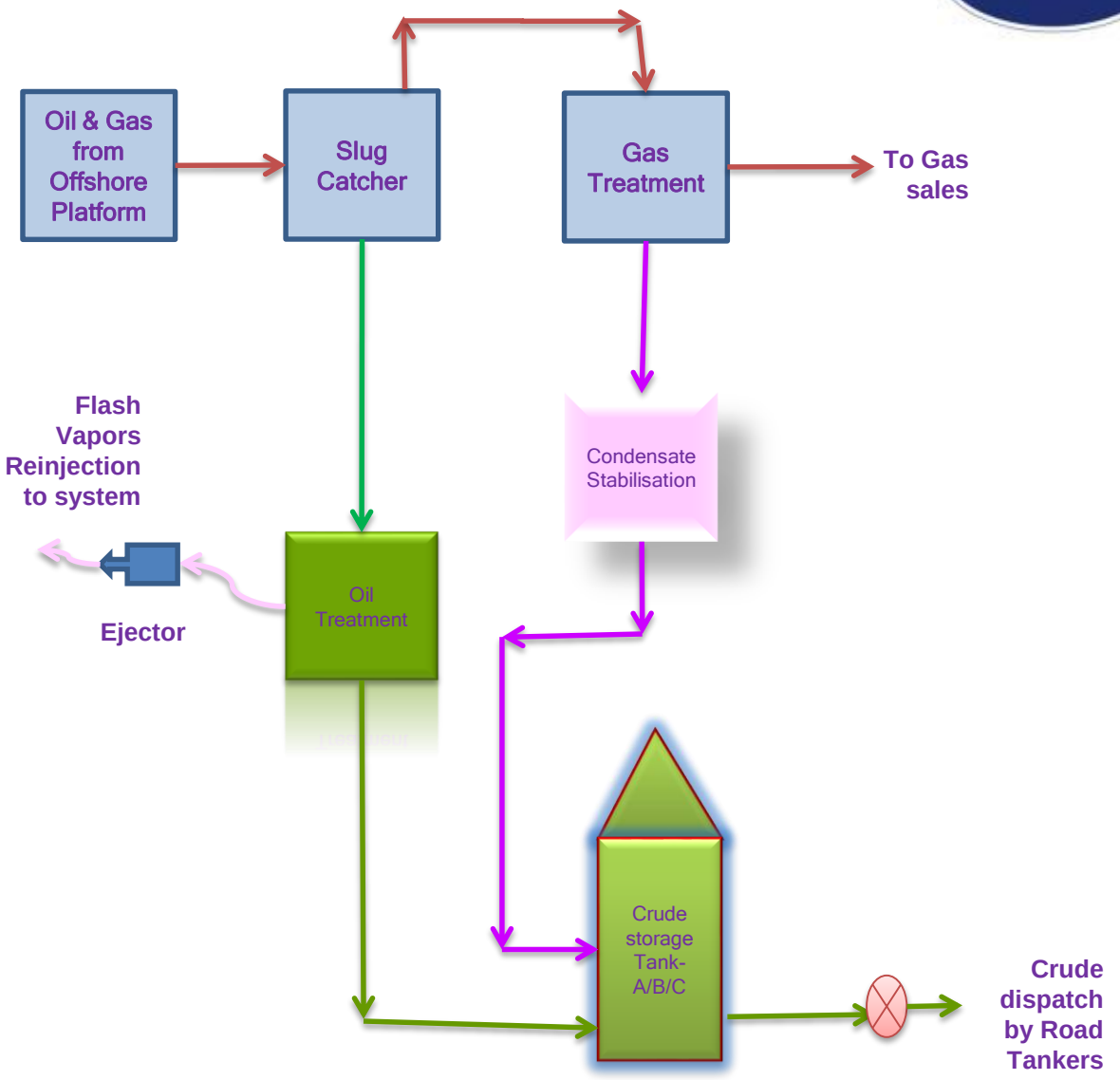
GMI- Challenges to Opportunities

- Methane is an important climate change forcing greenhouse gas (GHG) which has a climate forcing effect 25 times greater on a 100 year basis than that of carbon dioxide, the primary greenhouse gas (GHG).
- There are many ways to reduce methane emissions, both fugitive (from leaks) and vented (from released-through bleeds, blow down, combustion or venting etc.)source.
- Reducing methane emissions add incremental revenue and also reduce - at no extra cost - the conventional pollutants that can harm public health and the environment.

Source: ICF International "Economic Analysis of Methane Emission Reduction Opportunities in the U.S. Onshore Oil and Natural Gas Industries; March 2014

Process Overview: Suvali Oil & Gas processing Unit

- The **Oil & Gas produced** from the offshore fields is processed at onshore terminal.
- Natural Gas is being **conditioned** and put in the state gas grid.
- **Crude oil & condensate** generated after **treatment** (in two separate stream) is stored in fixed roof tank.
- The processed **oil is loaded** in 20 KL / 24 KL road tankers. It is a top loading system and complete manual operation.



3-Stage Emission Reduction Program: :

STEP - I

- **Providing the flash Vapor vent system at crude loading bay area.**
  - To divert vapour at crude loading bay to minimize personal exposure.

STEP - II

- **Diverting Unstabilised condensate to Oil stabilisation unit .**
  - To minimise vapor generation and losses due to flashing

STEP - III

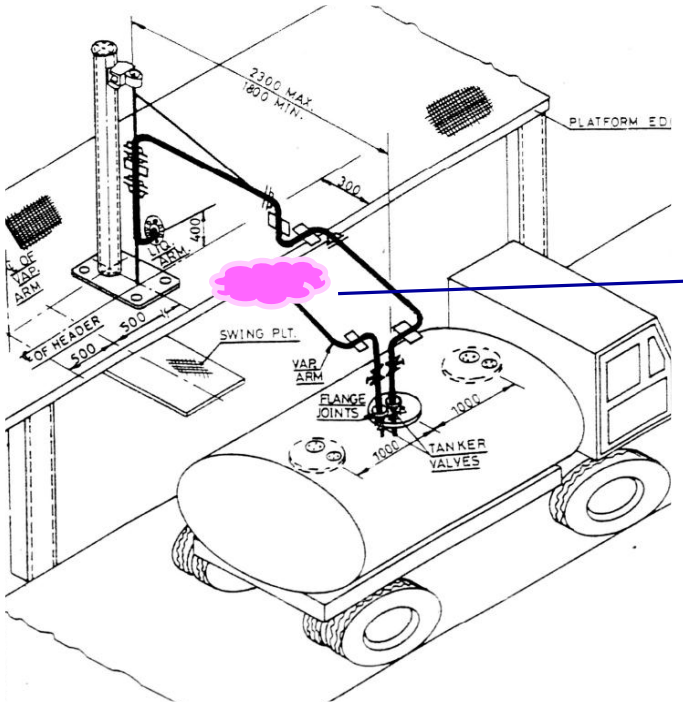
- **Providing Crude Tank Vapor balancing & Nitrogen blanketing in place of valuable Fuel gas :**

- For optimum utilisation of flash vapor's
- Nitrogen blanketing provides additional safety protection for storage tanks.

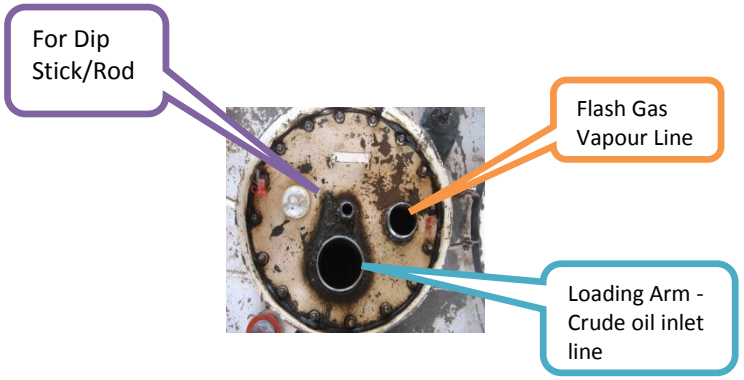
❖ STEP-I

Providing the Vapor vent system at crude loading bay (*Before Modification*):

Loading Bay Roof



Flash vapors venting to atms near tanker loading area



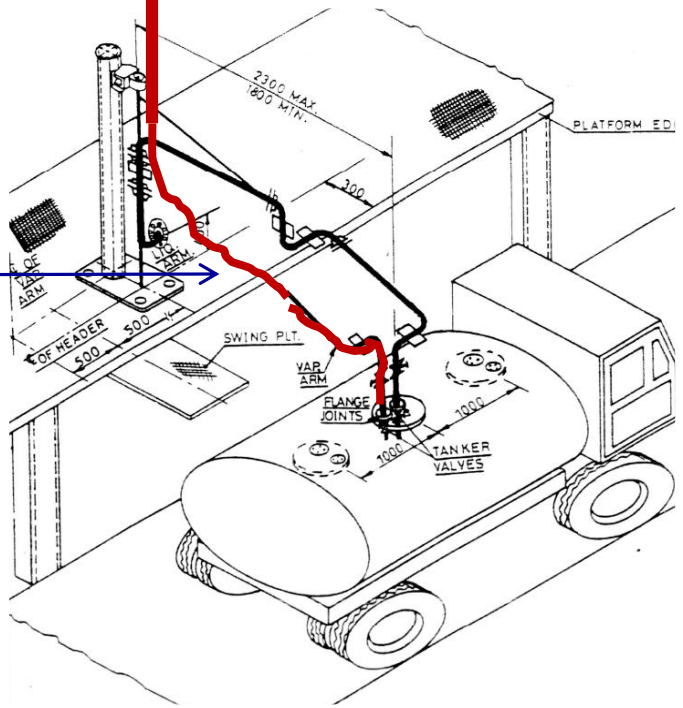
❖ STEP-I

Providing the Vapor vent system at crude loading bay (*After Modification*):

Flash vapors venting to atms in safe area/ above the loading bay roof

Loading bay Roof

Flexible conductive hose connection



Reduced the vapor Exposure to crude loading personals

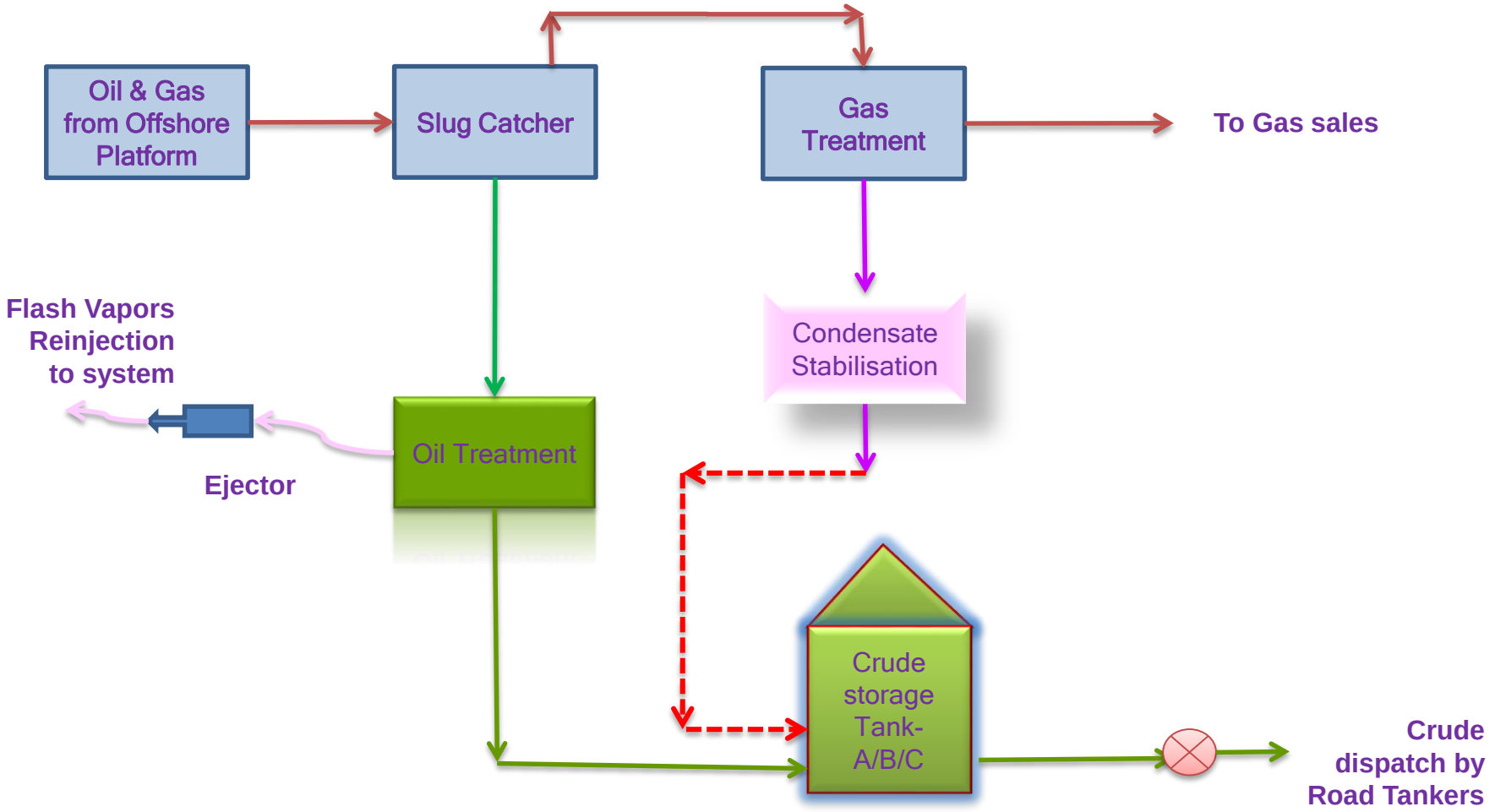
Crude Loading bay overview (after implementation of STEP-I):

STEP - II - Diverting Unstabilised condensate to Oil stabilisation unit .

- ✓ To minimise vapor generation & losses due to flashing

STEP-II : Diverting Un-stabilized condensate to Oil stabilisation unit.

Process Flow Diagram (Before Modification):



STEP-II : Diverting Un-stabilized condensate to Oil stabilisation unit.

❖ **Issue:**

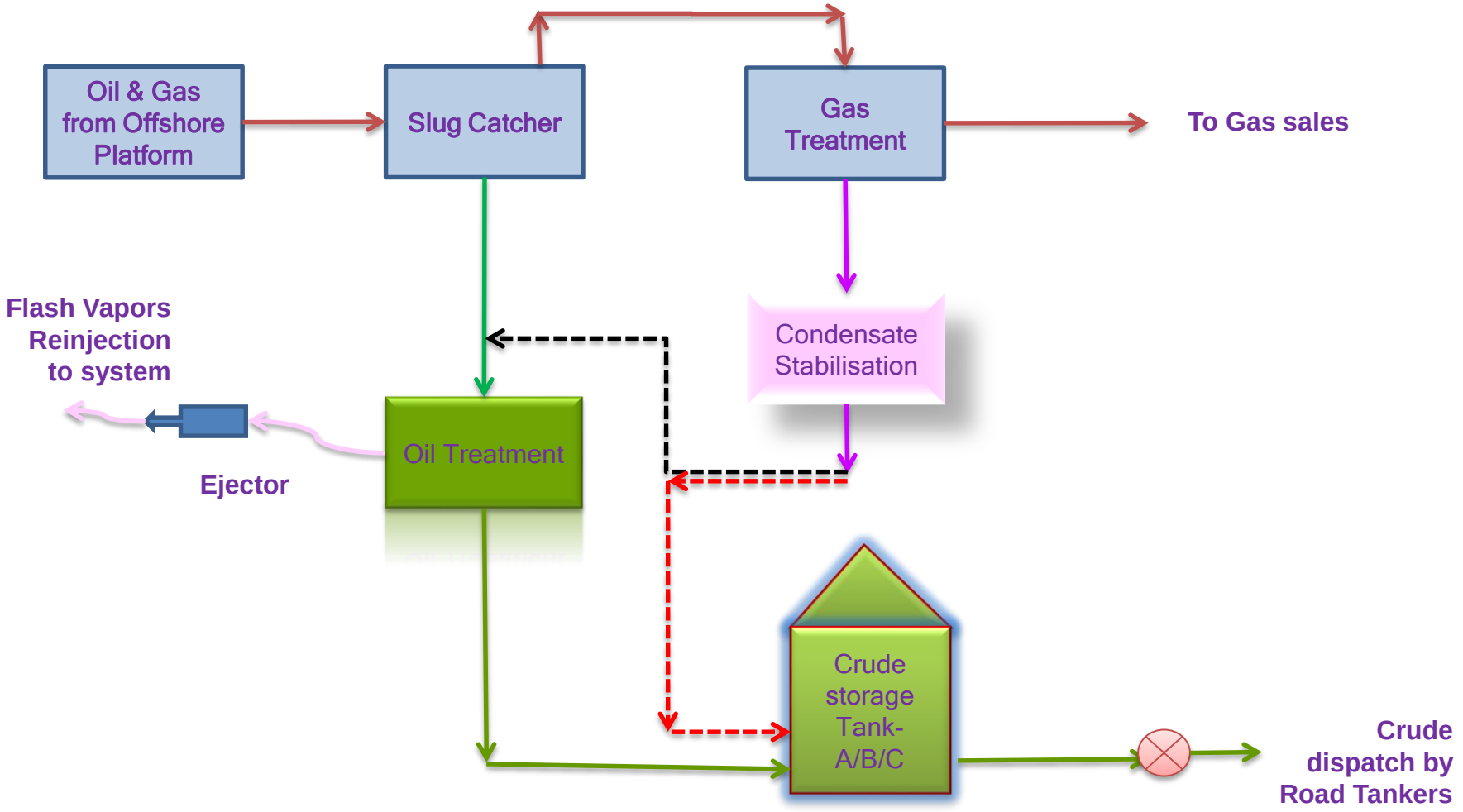
- Observed **Condensate not getting stabilized** due to unsteady state flow rate
- Crude Oil Product **RVP was in the range of 4.5 to 5.0 Psig** (Ideal RVP should be < 1.0 psig).
- Causing **more vapor flashing & emission** from the Crude Storage tank (~ 60 to 65 scm/hr) and at the loading bay.

❖ **Corrective Actions:**

- Unstabilised **condensate diverted to Oil Stabilisation** Unit inlet.

STEP-II: Diverting Un-stabilized condensate to Oil stabilisation unit.

Process Flow Diagram (After Modification):



STEP-II : Benefits

- This has resulted **drastic reduction in flash vapor generation rate up to ~ 15 to 20 scm/hr** from ~ 60 to 65 scm/hr due to reduction in Crude Oil Product RVP from 4.0 to 5.0 psig to 1.2 to 2.0 psig.

- Generation **of flash Vapors** in Oil handling section which **are being recovered by Mechanical Ejector & injected back** to natural gas stream.

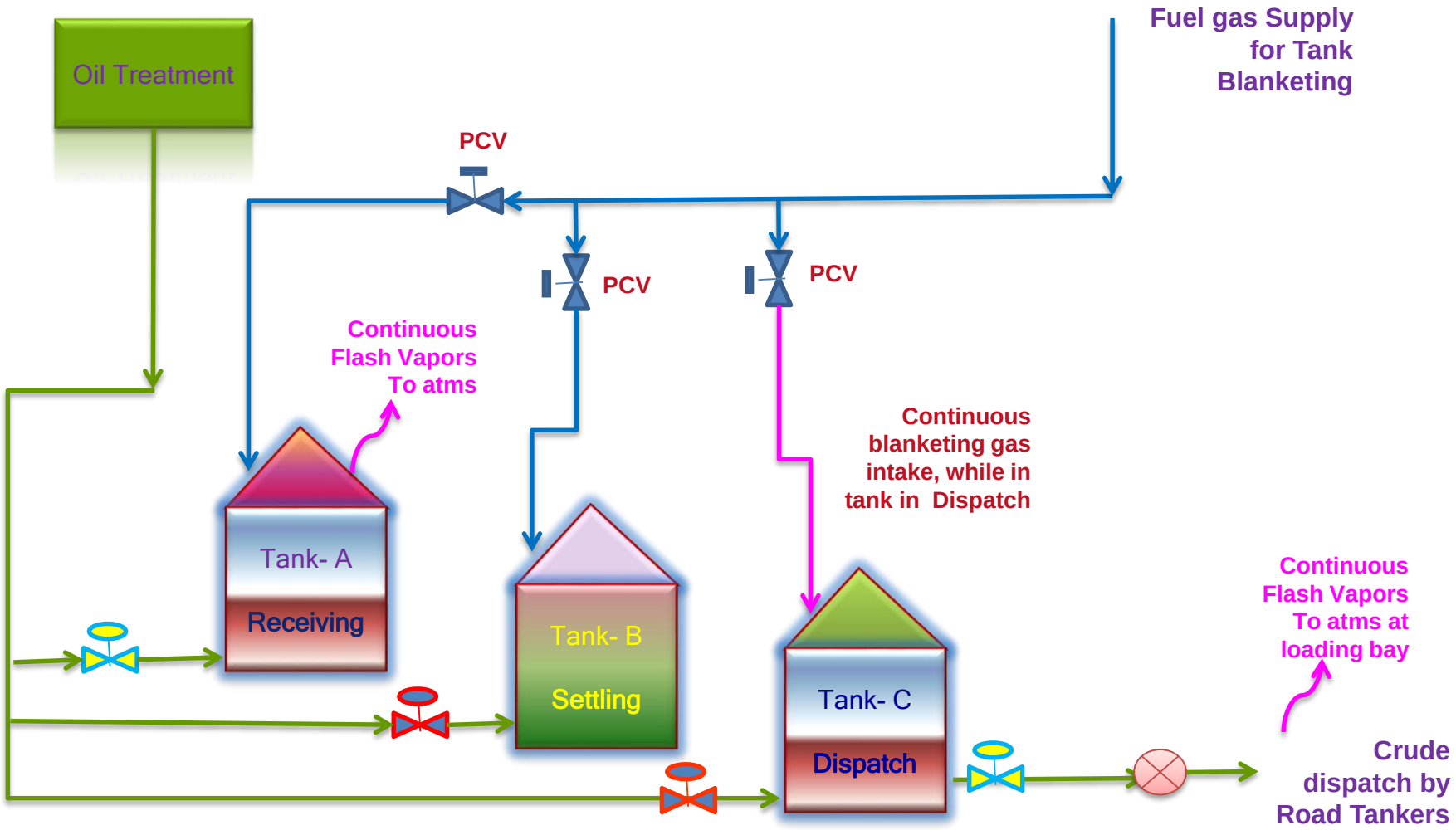
- Reduction in RVP at Loading bay and Storage tank, **correspondingly reduction in HC vapor emission**.

- **Revenue generation of around ~ INR 35.0 Lakhs/Annum**. Due to vapour recovery at Oil stabilisation unit.

STEP - III - Providing Crude Tank Vapor balancing & Nitrogen blanketing in place of valuable Fuel gas :

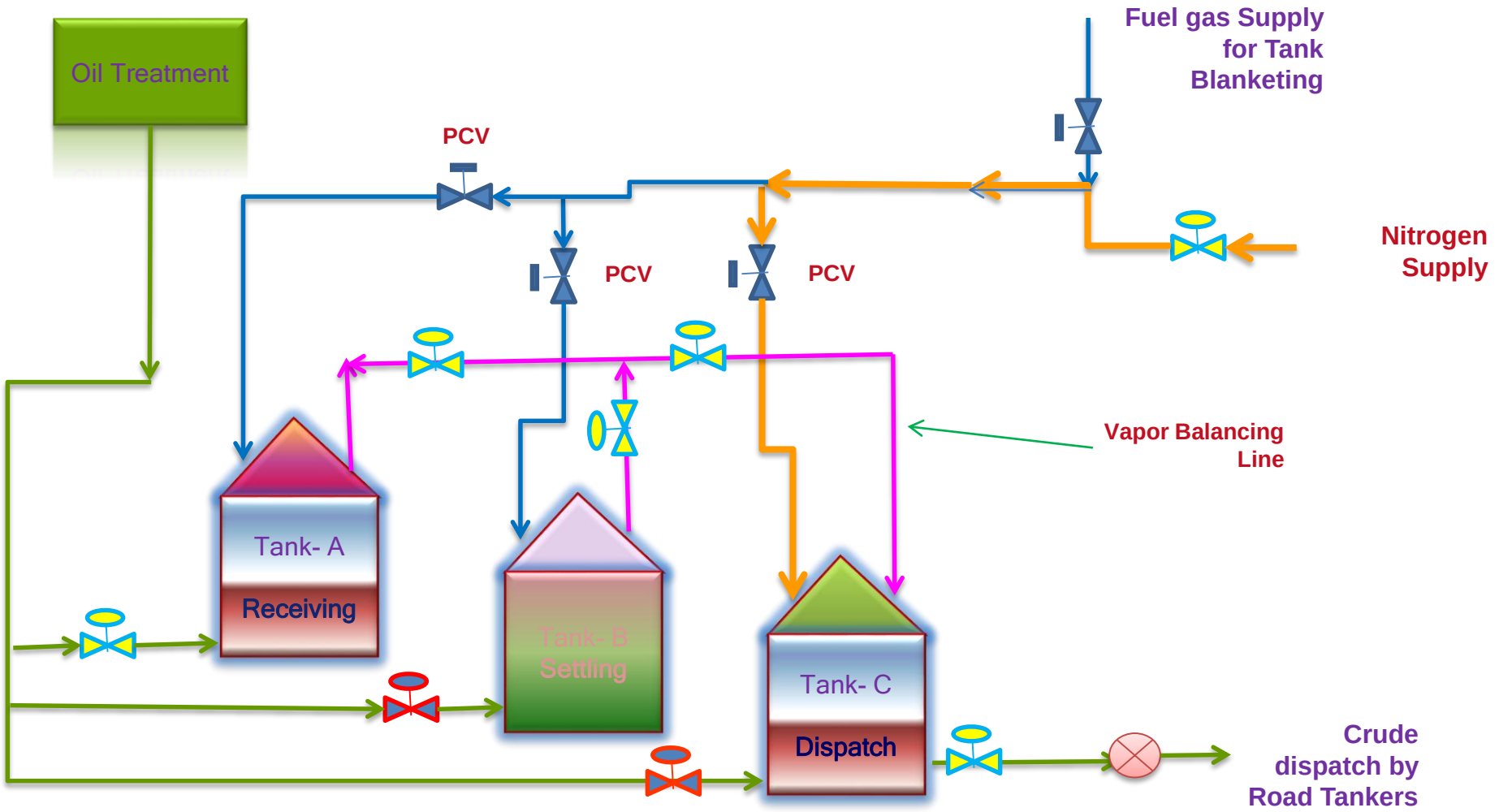
- ✓ For optimum utilisation of flash vapor's
- ✓ Nitrogen blanketing provides additional safety protection for storage tanks.

STEP-III: Process Flow Diagram (Before Modification):



STEP-III

❖ Providing Crude Tank Vapour balancing & Nitrogen blanketing:



STEP-III: Providing Crude Tank Vapour balancing & Nitrogen blanketing:

- Crude tank Vapour balancing across the three tank, has resulted to optimum utilisation of flash vapors generated (15 to 20 scm/hr) while crude tank is in receipt mode & while crude tank is in dispatch mode.

- Reduced the venting of flash vapors to atms at the rate of ~50 scm/hr through Crude tank PVSV, while the tank is in receipt mode. The tank when in dispatch mode consumes fuel gas at the rate ~ 120 m3 / hr.

- Nitrogen blanketing has addedd additional safety protection for crude storage tanks.

- By providing the low cost Nitrogen blanketing in place of natural gas. (by 8-9 times)

  (Cost of nitrogen production is INR 1.62/sm3. Where as cost of treated Fuel gas is INR 9.72 /sm3).

Outcomes:

- **Benzene exposure level reduced to Zero PPM from 0.4 PPM, to loading personal** during crude loading operations.

- **Reduction in cold venting** (GHG emissions) from crude storage tank & at crude loading operations.

- **Nitrogen blanketing** provides additional safety protection for crude storage tanks.

- **Conservation of natural resource**:
  - ✓ Effective utilization of flash vapors

- **Revenue Generation up to ~ 60.0 to 70 Lakhs/Annum** by optimization of natural gas usage and recovery of condensate vapor at Oil Stabilisation.

Lessons from this case study:

- Minimize HC exposure to personnel- In line with **organisation's commitment towards Occupational health.**
- Minimize GHG emissions - **Contribution towards organizational commitment to sustainable development**
- Minimise Resource Depletions – Overall **natural resource conservation**
- In addition to the above, such programs can lead to incremental revenue Generation – Financial g**ains to organization & Nation**

Methane Emission Reduction Programs in Other Assets

- Vapor recovery units commissioned at the Mangala Processing Terminal (MPT) to recover ~1.5 MMSCFD associated gas
- Installation of low NOx flare tip with modified design has reduced the consumption of associated gas by ~0.5 MMSCFD. (MPT)
- Plant O&M initiatives to eliminate fugitive emissions: > 90% success in arresting flange/pipe/hose leaks (~3 mmscf/annum)
- Emission reduction targets set right upfront in the Engineering design/Stds.
- No cold venting permitted and if unavoidable (high CO2) flaring is allowed thereby reducing Methane emissions

Emission Reduction other Initiatives

- Measurement key to Management - Baseline Survey completed with the help of USEPA GMI program in 2014
- **Options being looked into capturing flow back gas during fracing using a DST module with oil-gas separator.**
- **Green completions : After drilling new wells, instead of venting the well to remove debris from around the well bore, green completions use additional separator traps and dehydrators to route gas to sales.**
- **Trial runs using brackish water for fracing in progress for maximum recycling and conservation of water.**
- **Other Initiatives includes W2E/W2R, Water Management Strategy, Emission and energy conservation Strategy, Alternate Energy use , Massive GB Development including Mangrove and Shelterbelts in about 50% of the total occupied area, partnership with IUCN for Bio-diversity/Eco-service resource Conservation etc.**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Thank You