



R-P1: (M5127605) Refractory Ceramic Coatings of Hydrogen Reformer Unit F-1901 (radiant section)

Present to VAC | Date: 22 DEC 2020

Presenters:

Project Engineer	: Wachira Put <TP-PP-PB>
Process Engineer	: Kanyaporn L <R-P1-TE/1563>
Project Initiator	: Kanyaporn L <R-P1-TE/1563>



Project Information	<div><div>MoC No:</div><div>R-P1-2018/121</div></div> <div><div>Project No.:</div><div>CP-1011-19006</div></div> <div><div>Project Title:</div><div>(M5127605) Refractory Ceramic Coatings of Hydrogen Reformer Unit F-1901 (radiant section)</div></div> <div><div>Project Location:</div><div>R-P1</div></div>																								
Current Status	<div><div><div><div><div>Phase I</div><div><div>Plan Gate1: 5 Sep 2018</div><div>Actual Gate1: 9 Nov 2018</div></div></div><div>Gate 1</div><div><div>Phase II</div><div>Skip</div></div><div>Gate 2</div><div><div>Phase III</div><div><div>Plan Gate3: 12 Dec 2018</div><div>Actual Gate3: 27 Dec 2018</div></div></div><div>Gate 3</div><div><div>Phase IV</div><div><div>Plan Gate4: 22 Dec 2020</div><div>Actual Gate4: On Process</div></div></div><div>Gate 4</div></div><div><div>We are here</div></div><div><div>MEETINGS</div><div><div>PASSED:</div><div>✓ -</div></div><div><div>NEXT:</div><div><div><input type="checkbox"/> VAC 22 DEC 2020</div><div><input type="checkbox"/> PIC 15 JAN 2021</div></div></div></div><div><div>Current Phase:</div><div><div>Phase IV</div><div><div>✓ e-MOC Status : Completed</div><div>✓ SAP Status : Technically completed</div><div>✓ Execution Lookback Status : Published</div></div></div></div></div></div>																								
Today's Objective	<div><div>Project request PIC to endorse as following details.</div><div><div>Proposal for:</div><div>Performance Lookback</div></div><div><div>Investment Type:</div><div>Sustain Core (Energy Saving)</div></div><div><div><div>Performance Lookback Information:</div><table><tr><th>Evaluating items</th><th>Estimated</th><th>Actual</th><th></th></tr><tr><td>Budget (MTHB)</td><td>11.6</td><td>8.8</td><td></td></tr><tr><td>Schedule</td><td>Dec 2018 – Nov 2019</td><td>Dec 2018 – Oct 2019</td><td></td></tr><tr><td>Benefit (MTHB/Year)</td><td>8.75</td><td>4.65</td><td>Not Achieve</td></tr><tr><td>IRR (%)</td><td>77.04</td><td>55.25</td><td>Not Achieve</td></tr><tr><td>Payback (Year)</td><td>2.08</td><td>2.59</td><td>Not Achieve</td></tr></table><div>Not achieve both estimated benefit and IRR</div></div></div></div>	Evaluating items	Estimated	Actual		Budget (MTHB)	11.6	8.8		Schedule	Dec 2018 – Nov 2019	Dec 2018 – Oct 2019		Benefit (MTHB/Year)	8.75	4.65	Not Achieve	IRR (%)	77.04	55.25	Not Achieve	Payback (Year)	2.08	2.59	Not Achieve
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Agenda

- 1. Introduction**
- 2. Project Background, Objectives & Scope**
- 3. Project Benefit & Justification Evaluation**
- 4. Gap Identification**
- 5. Project Lessons Learned**

1. Introduction

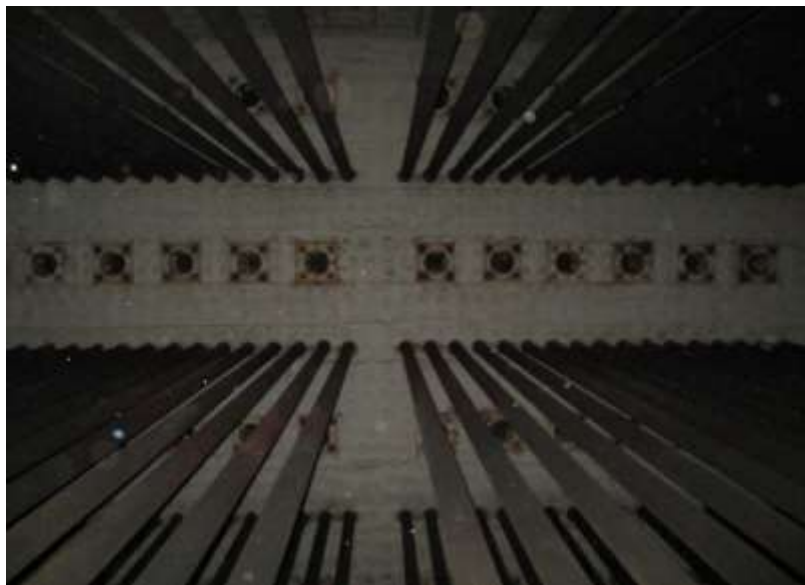
MOM: PIC monthly meeting 27 Dec 2018

<p>R-P1 Refractory Ceramic Coatings of Hydrogen Reformer Unit F-1901 (radiant section) project</p> <p>Project request PIC to endorse Gate 3 ($\pm 10\%$)</p> <p>Project budget: 11.6M THB</p> <p>Investment type: Sustain Core (Energy Saving)</p> <p>Benefit: 8.75M THB/Year</p> <p>IRR: 77%</p> <p>Payback: 2.08 Year</p> <p>Project Schedule: Dec 2018 – Nov 2019 (T/A REF 2019)</p> <p>PIC endorsed Gate 3 to use MAX infinity budget with comment.</p> <p>Comment:</p> <ol style="list-style-type: none">1. Project team consider heat recovery efficiency of HMU unit by refer to stack temperature.2. Project team to re-check guarantee period (8 years) from other refinery plant in PTT for reference. Done, Historical Data checked Refinery (F1501/2/3/4) guarantee 8 years3. During bidding state, the cost comparison shall be considered by area unit with separate cost of guarantee. Done, comparison in proposal for award4. Project budget shall be used MAX infinity budget. Done, Used MAX infinity budget	Wachira Pu. and Team	Nov 2019
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1. Introduction

Ceramic coating had implemented in T/A2019

Before



After



2. Project Background, Objectives & Scope

Project Background:

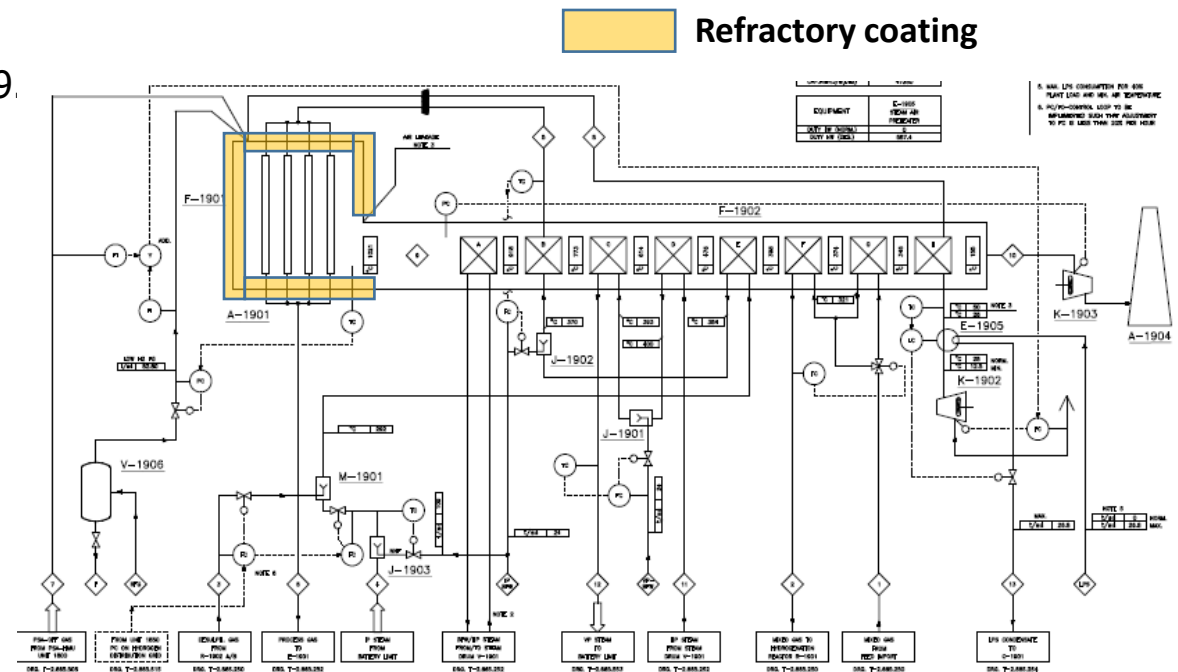
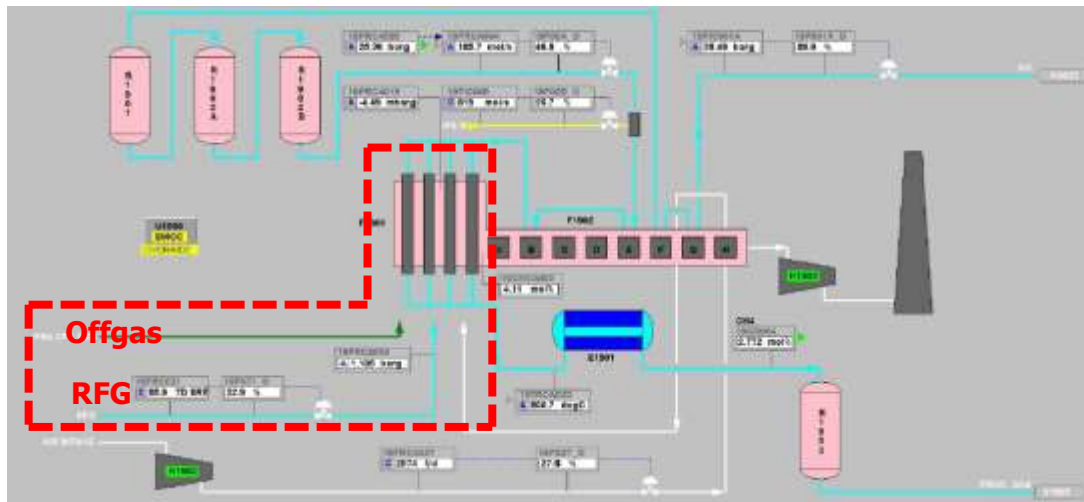
- F-1901 is hydrogen reformer furnace.
- Reforming reaction is conducted at high temperature and is highly endothermic.
- Heat of reaction is supplied by firing externally to catalyst packed tube in radiant section of the reforming furnace.
- Therefore, the heater needs keeping the desired temperature by using huge amount of heat.
- F-1901 is running at average firing rate 124 tSRF/d since HMU turndown.
- To apply refractory ceramic coating to reduction of fuel (RFG) consumption.

Project Objectives:

- To improve fuel efficiency of F-1901. Coat F-1901 refractory with high emissivity coating to reduce fuel consumption by 2.7%.

Project Scope:

- Refractory coating by high emissivity material.
- Scaffolding and lighting will be responsible by T-TA-TD during TA2019.



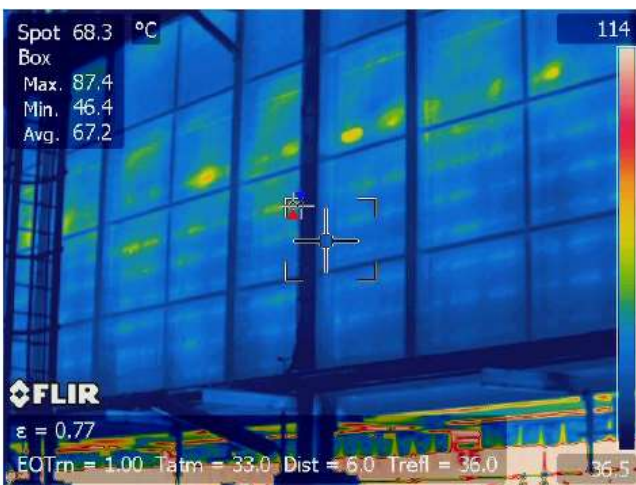
3. Project Benefit & Justification Evaluation

❖ HMU production 65 T/d

Before



After



			Before implement	After implement
Start			31/7/2019 13:00	19/12/2019 12:30
End			1/8/2019 13:00	20/12/2019 12:30
Process side	Tag	UOM	Value	Value
Hydrogen Production Rate	18FR102.MEAS	T/D	61.87	58.97
NG Flow Rate	19FR040.MEAS	T/D	179.97	178.07
Temp in F1901	19TI028.PNT	degC	525.76	522.38
Temp out F1901	19TRCA033.MEAS	degC	809.88	810.36
Bridge Wall Temperature	19TRCA044.MEAS	degC	867.18	852.76
Stack Temperature:	19TI056.PNT	degC	183.48	179.57
Draft	19PRCA019.MEAs	mbar	-3.50	-3.50
RFG	19FRC031.MEAS	TSRF/D	99.85	91.20
Offgas	19Y019	TSRF/D	50.29	49.96
Firing rate	Cal	TSRF/D	150.13	141.16
Steam Boiler: Flow	19FT016.MEAS	T/hr	63.62	60.09
Steam Boiler: Pressure	19PRA027.PNT	Barg	121.81	121.57
Steam Boiler: Temperature	19TI067.PNT	degC	324.48	324.23

High emissivity coating → Increase radiant heat transfer efficiency

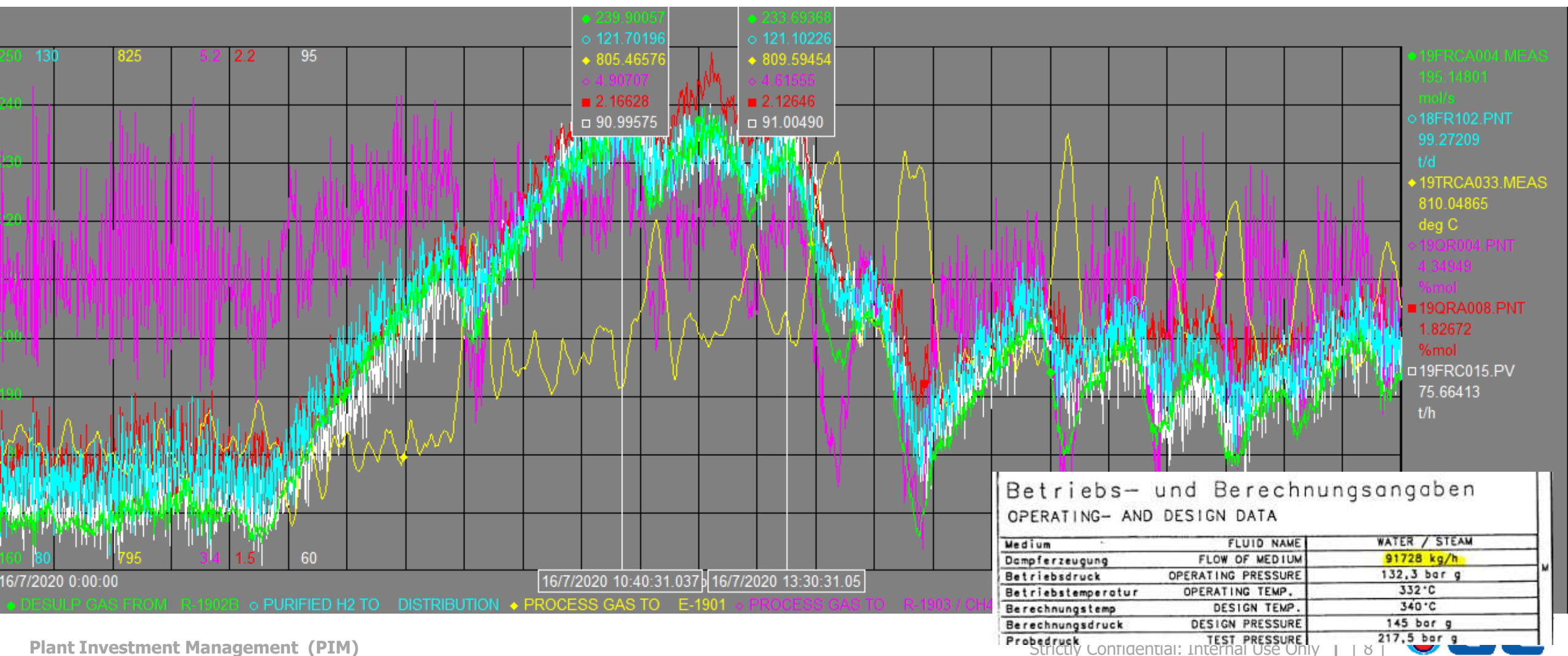
- **Fuel gas consumption decrease**
- **Flue gas at bridge wall temperature decrease**

VPS product from convection section of furnace is reduced

3. Project Benefit & Justification Evaluation

HMU test max capacity in Jul-20 (after ceramic coating)

At max capacity H2 production 121 t/d, VPS production 90-91 t/d (boiler register = 91.73 t/d)



3. Project Benefit & Justification Evaluation

Economic Evaluation:

Information during project was approved

		2019	2020	2021	2022	2023	2024	2025	2026	2027
NG industrial (LHV)	THB/MMBTU		332.9	333.0	351.3	377.6	385.1	389.7	396.8	401.8
Total saving	MTHB/Year		11.03	10.99	10.15	12.47	12.75	11.26	13.10	13.27

- Benefit from coating with higher emissivity in HMU furnace and result in NG saving 2.7% from base case
- Total furnace firing = 14186 tSRF/d at H2 production =70 t/d.
- Benefit calculation take at 70% because of guarantee.
- Project life 8 years from ceramic coating life.
- VPS loss from fuel saving is calculating by Fuel saving x 70% guarantee x 26% convection eff x 50% boiler eff.
- Investment cost = 11.6 MTHB

	MUSD/year	MTHB/year
Avg EBITDA, M\$/yr (Avg 2020-2027)	0.36	11.6
Avg Net Income, M\$/yr (Avg 2020-2027)	0.27	8.7
IRR @ 8 years	77.04%	
NPV @ 9.72%	0.74	24.0
Payback (including construction period 0.8 yrs)	2.08	

Actual Information during stable operation

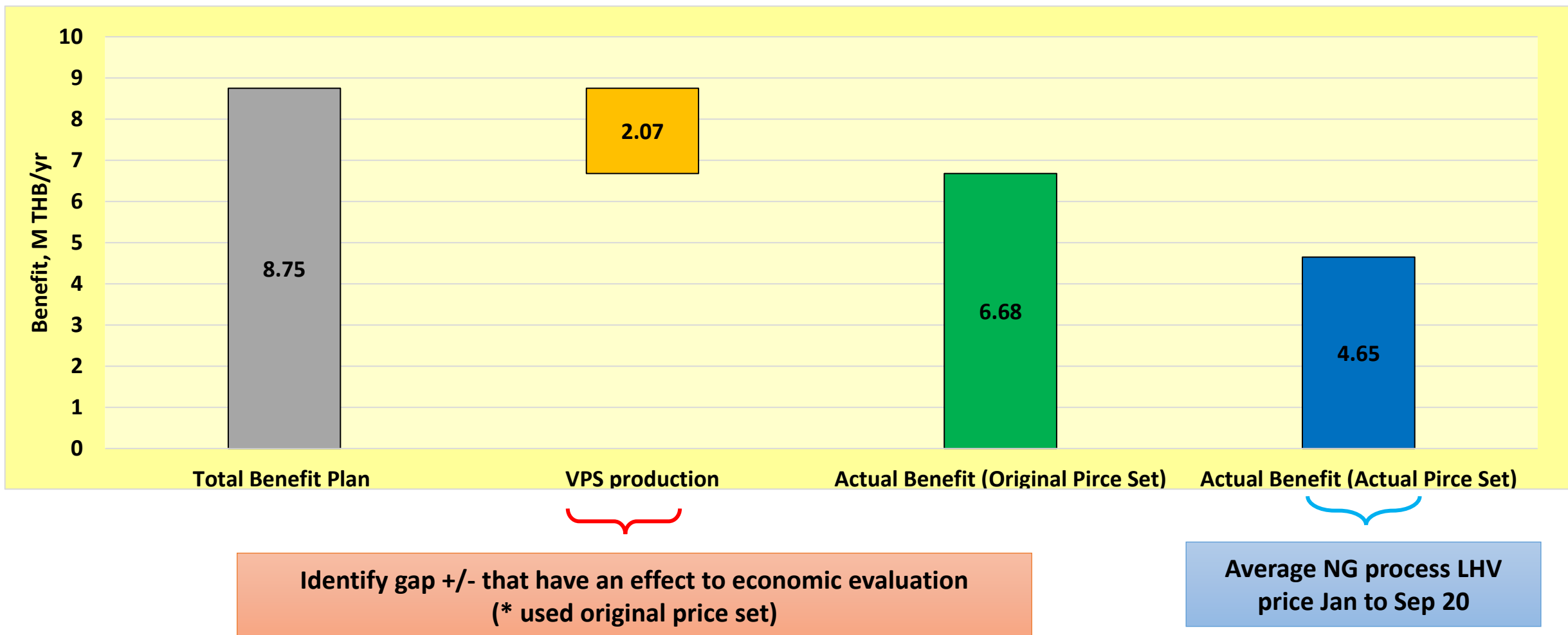
		2019	2020	2021	2022	2023	2024	2025	2026	2027
NG industrial (LHV)	THB/MMBTU		242.7	252.1	255.3	262.2	270.5	281.9	286.8	290.2
Total saving	MTHB/Year		5.95	6.18	6.26	6.42	6.63	6.91	7.03	7.11

- VPS production decrease from ceramic project more than target (average 3.9 t/hr).
- Average NG price Jan20 to Sep20 (LHV) = 242.674 Baht/MMBTU
- Investment cost = 8.8 MTHB

	MUSD/year	MTHB/year
Avg EBITDA, M\$/yr (Avg 2020-2027)	0.20	6.3
Avg Net Income, M\$/yr (Avg 2020-2027)	0.14	4.65
IRR @ 8 years	55.25%	
NPV @ 9.72%	0.27	8.8
Payback (including construction period 0.8 yrs)	2.59	

3. Project Benefit & Justification Evaluation

Benefit Clarification:



4. Gap Identification

All gaps are identified and explained as table below.

Benefit Items	Gap (MTHB/Year)	Reason of Deviation	Mitigation or Suggestion
1. VPS production	- 2.07	<p>VPS production loss from ceramic coating is higher than estimate</p> <ul style="list-style-type: none">• VPS loss from fuel saving is calculating by Fuel saving x 70% guarantee x 26% convection eff x 50% boiler eff = 6 t/d• Actual VPS loss = 3.9 t/hr	VPS decrease at HMU can be produced at HRSG.

5. Project Lessons Learned

Detail of Lessons Learned and Recommendation for next project

Technical	<ul style="list-style-type: none">• Benefit calculation should be considered effect from downstream e.g VPS production decrease because vendor did not consider.• Furnace eff is calculated from multivariable and there are a lot of parameter impact to furnace eff i.e. fuel composition, furnace feed characteristic, operating condition of the furnace.• It is difficult to control the furnace at the same basis of above mention parameters
Price	<ul style="list-style-type: none">• NG assumption price vs actual price are different.
Volume	<ul style="list-style-type: none">• -
Other (if any)	<ul style="list-style-type: none">• Execution phase, Ceramic (for coating) be so stained with scaffolding therefore there were additional scope of cleaning with scaffolding vendor. To protect this problem for next project, 1) include scope of scaffolding to Main Contractor (Ceramic Coating Contractor) 2) During execution, make sure the protection are covered and scope of cleaning are clarified.

Thank You

