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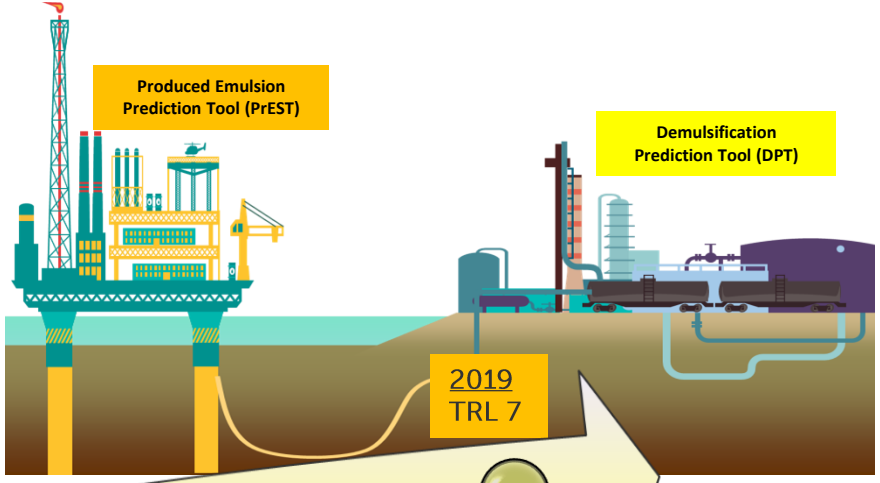
Proposal on TRLC for TRL7

Demulsification Prediction Tool (DPT)

28.06.2021

Technology Maturation: iPrEST + DPT



PrEST Achievements:

- ✓ Developed emulsion stability correlation based on 46 wells (TRL 4)
- ✓ Validate the correlation with another 18 wellhead crude samples (TRL 6)
- ✓ Developed PrEST software in PETRONAS Tech Apps store (TRL 6)
- ✓ Validate the correlation with another 10 wellhead/ pipeline crude sample (TRL 7)

Produced Emulsion Prediction Tool (PrEST)

2014-2016
R&D Phase

Develop and test

2016
TRL 4

Pilot Demonstration

Q4 2019
TRL 4

2017
TRL 6

Release to Marketing (System Installed)

2019
TRL 7

Proven Technology

Q1 2017 – Q4 2019
R&D Phase

Q1 2021
DPT
TRL 6

Integration Produced Emulsion Prediction Tool + Demulsification Prediction Tool (iPrEST + DPT)

DPT Activities for TRL 6:

- ✓ Develop Prediction of Chemical EOR Demulsification using Computational Tool (TRL 4)
- ✓ Develop demulsifier formulation for Baronia, Angsi, Tukau, Sumandak

Demulsification Prediction Tool (DPT)

DPT Achievements:

- ✓ Develop demulsification tool to select the best demulsifier based on the demulsifier chemistry and property
- ✓ Develop Prediction of Chemical EOR Demulsification using Computational Tool (TRL 4)

Technology Replication:

Technology	TRL4	TRL6	TRL7
PrEST	Dulang, Baronia,Baram, Tukau, Samarang	Tukau, Baram, Samarang, Guntong, Tapis, Dulang, Sepat, Mehar (Pakistan), Bukit Tua (Indonesia)	Angsi, D18, NC3, D35, Temana
DPT	Dulang, Baronia, Samarang, Tukau	*Baronia, Angsi, Sumandak, Tukau	Samarang, Erb West

*Demulsifier formulation

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Technology Maturation-DPT

Demulsification Prediction Tool (DPT)

DPT Achievements:

- ✓ Develop demulsification tool to select the best demulsifier based on the demulsifier chemistry and property
- ✓ Develop Prediction of Chemical EOR Demulsification using Computational Tool (TRL 4)

2 IPs Obtained (21st Jan 2021):

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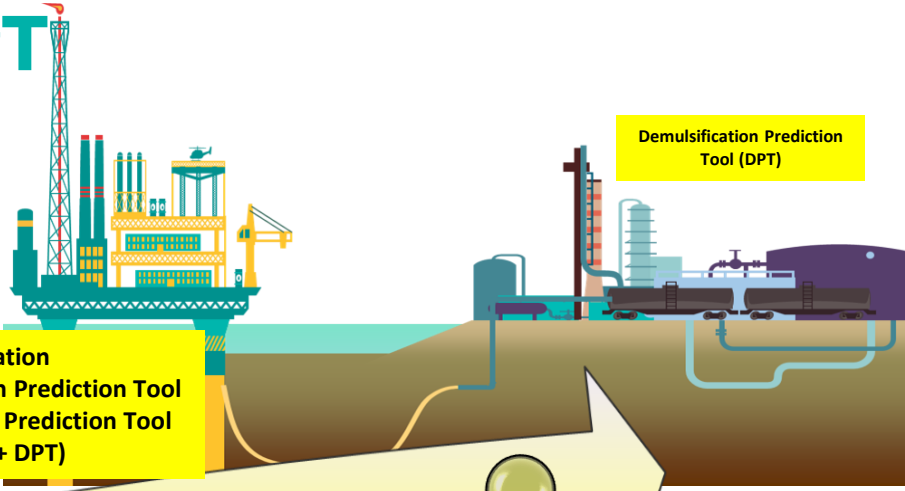
- ✓ Correlation Equation
- ✓ Demulsification Screening Tool



Develop and test

Pilot Demonstration

Release to Marketing (System Installed)

Proven Technology

Q1 2017 – Q4 2019
R&D Phase

Q4 2019
TRL 4

Q1 2021
DPT
TRL 6

Q4 2021
DPT
TRL 7

DPT Activities for TRL 6:

- ✓ Develop DPT Tech Apps Prediction of Chemical EOR Demulsification
- ✓ Develop demulsifier formulation for Baronia, Angsi, Tukau, Sumandak

DPT Activities for TRL 7:

- ✓ Replication to Samarang, Erb West
- ✓ Software enhancement

Technology Replication:

Technology	TRL4	TRL6	TRL7
DPT	Dulang, Baronia, Samarang, Tukau	*Baronia, Angsi, Sumandak, Tukau	Samarang, Erb West

*Demulsifier formulation

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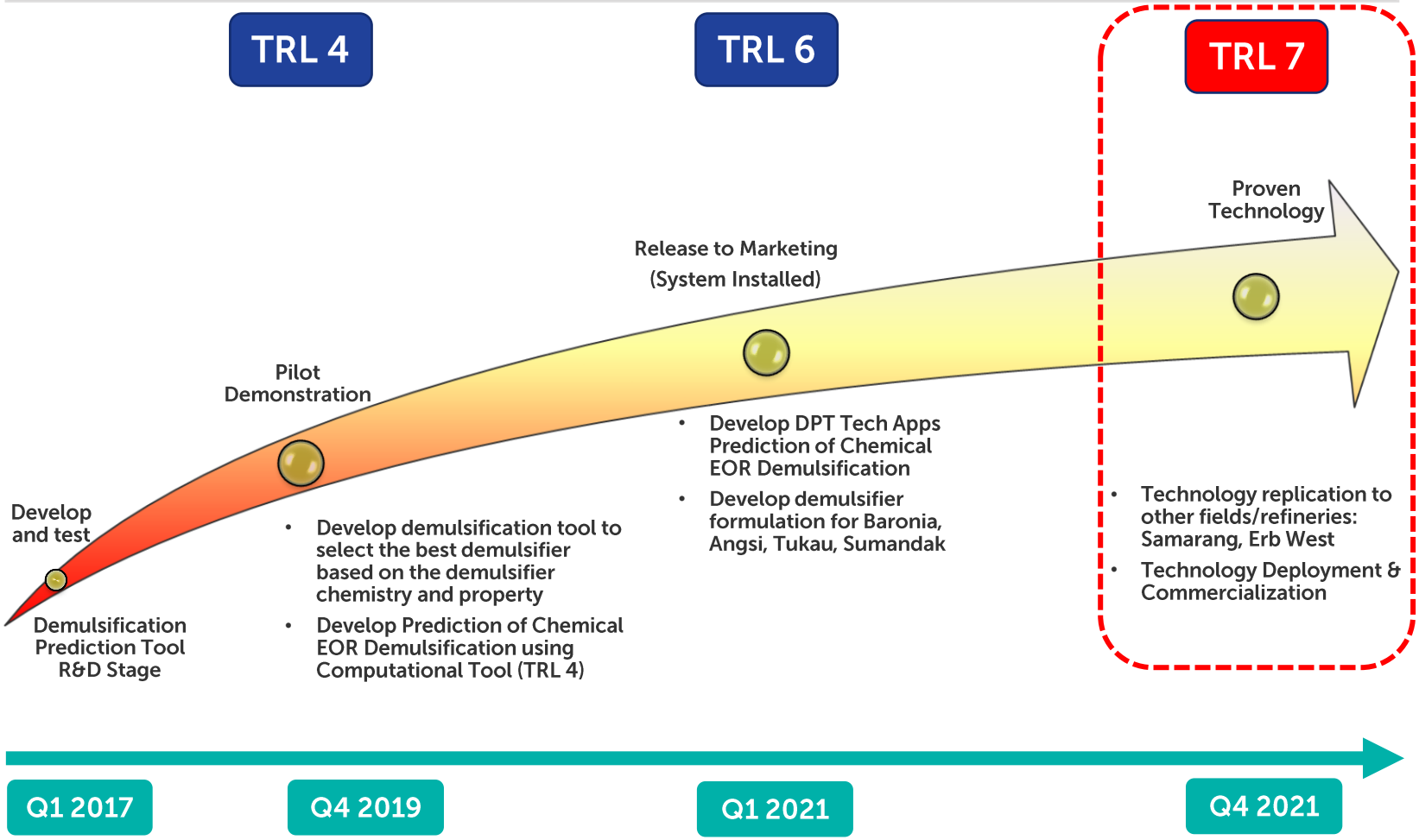
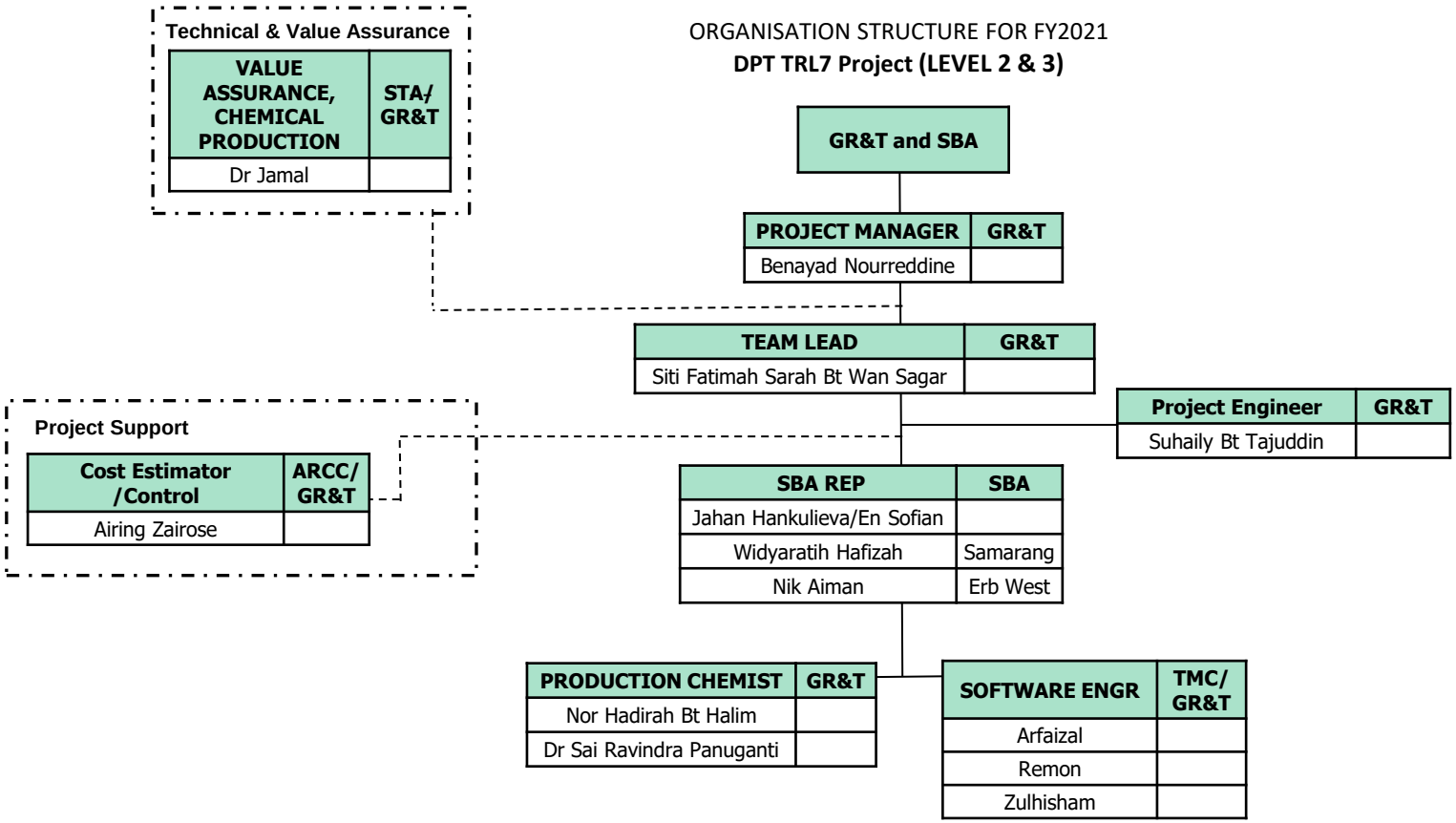
Demulsification Prediction Tool Readiness Level



Project Team Organization Chart



Prepared by: **Siti Fatimah Sarah Bt Wan Sagar** Team Lead, DPT Hydrocarbon Recovery Technology, GR&T	**Date:**	**Reviewed by:** **Benayad Nourreddine** Program Leader, Hydrocarbon Recovery Technology, GR&T	**Date:**	**Approved by:** **Salina Bt Baharuddin** Head Delivery, Hydrocarbon Recovery Technology, GR&T	**Date:**

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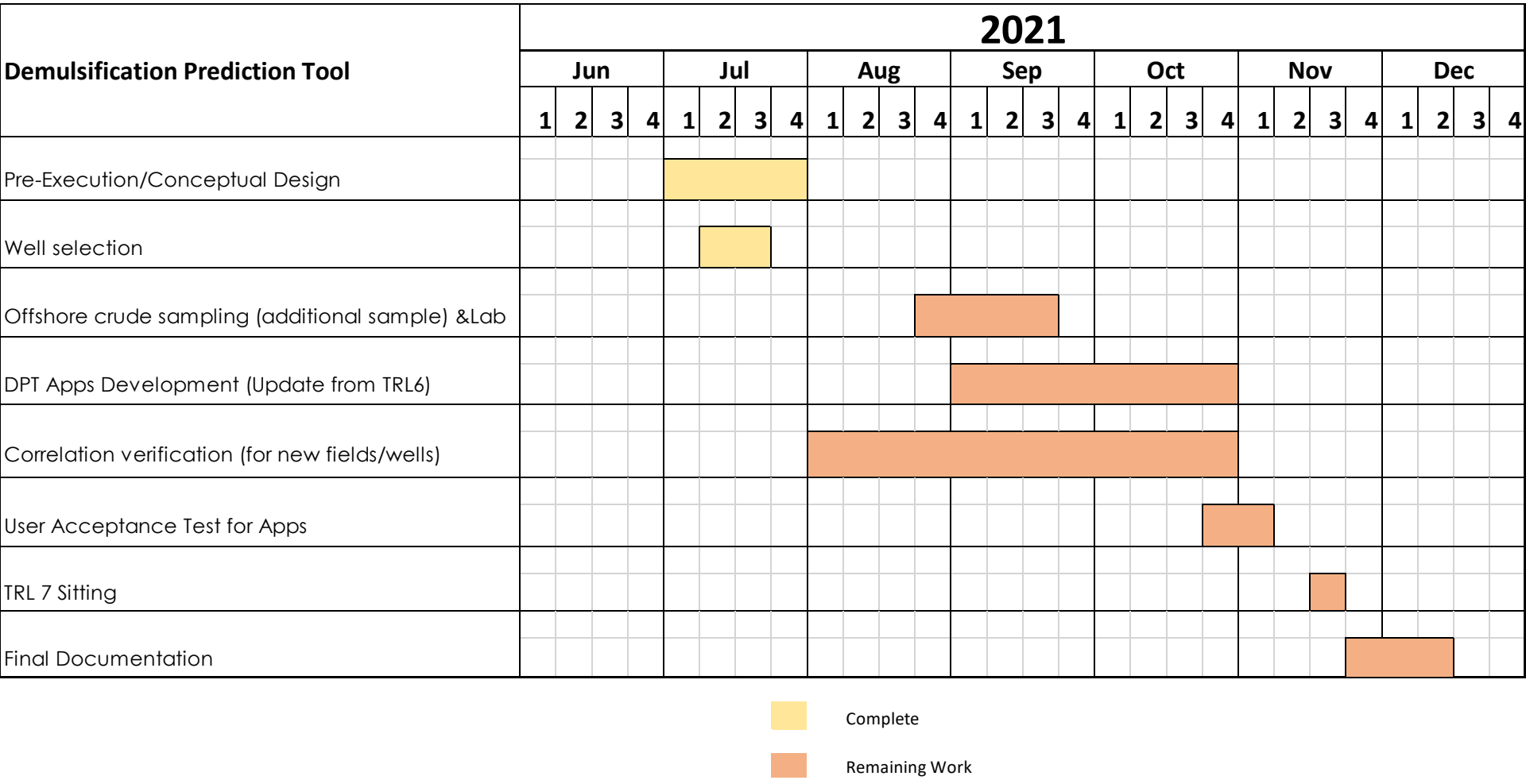
DPT Project Milestones (TRL7-Software)

Milestones	Completion Timeframe
Completion of Conceptual Design	Week 4 July 2021
Kick Off Meeting for Apps Development	Week 1 July 2021
Completion of Model Validation-Update	Week 4 Oct 2021
User Acceptance Test for Apps	Week 1 Nov 2021
Apps Update in PETRONAS Technical Apps Store	Week 2 Nov 2021
TRL 7 Sitting	Week 3 Nov 2021

DPT Project Schedule (TRL7-Software)

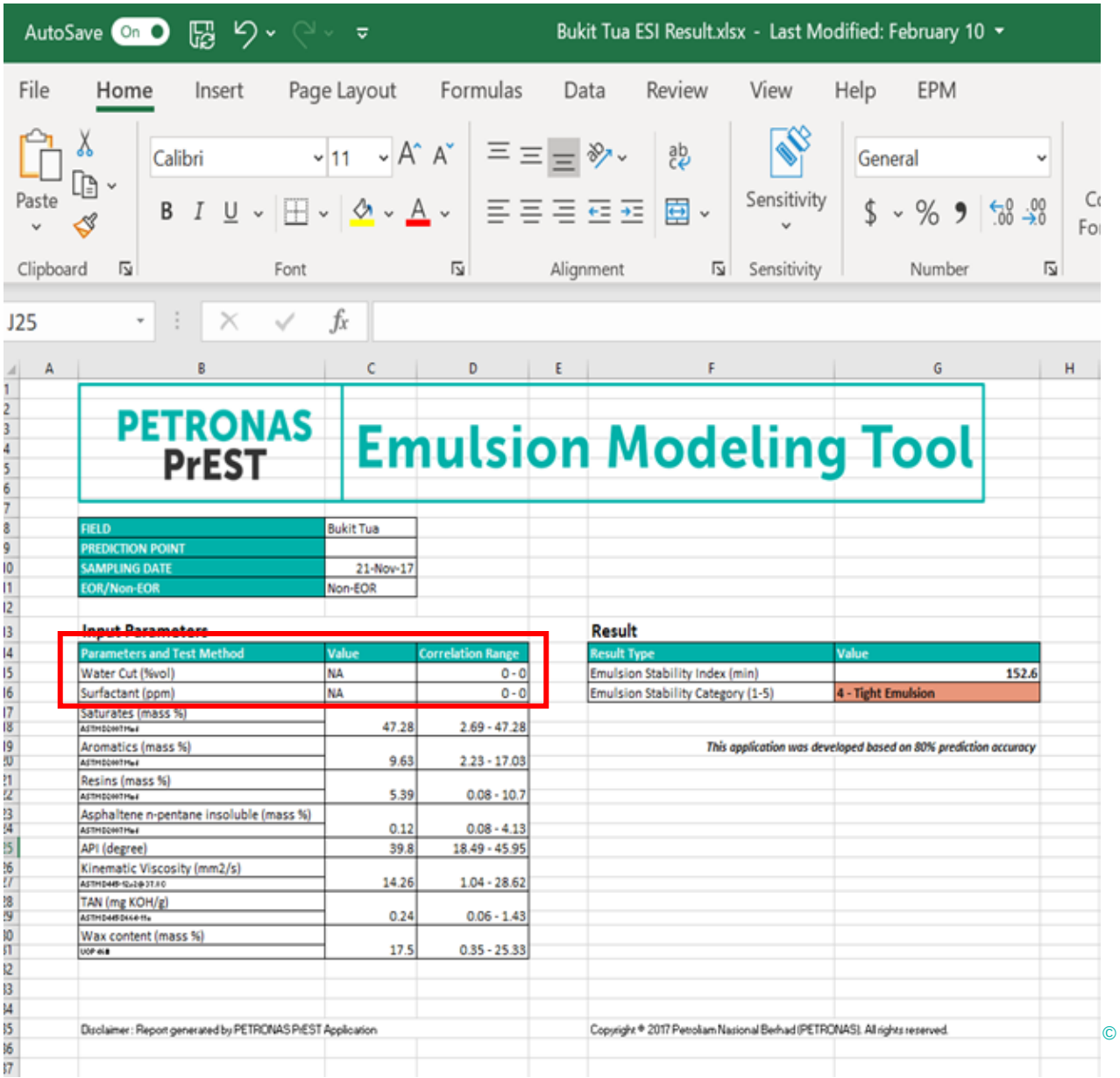


Tech Apps Feedbacks

Based on User Acceptance Test (UAT) session for TRL6

No	User	Asset	Well/ Field/ Project	Feedback	Action/Respond	Status
1.	WAN MOHD SHAFIE BIN WAN IBRAHIM (Production Chemistry)	PMA	PSS, PMA	This tool met the objective as a quick guide to screen the stability of emulsion and it is user friendly	No action required	SOLVED
2.	MOHD KAMARUDDIN BIN ISNIN Executive (Production Chemistry)	PMA	Dulang	1. Has reported an issue where Test Item 2 (Add new project) cannot be proceeded due to an error pop up. 2. For the time being, the software only can proceed if it been open via the icon in desktop. Other path will experience the issue.	1. Developer has attended the issue and notify it due to the path been used to open the software 2. Developer mention will work out with the software center to resolve it.	SOLVED
3.	MOHD SHAKIR BIN MOHD NAWI Executive (Production Chemistry)	PMA	Angsi	Has reported on unable to run the DPT Module with the following error msg	Developer has attended the issue and notify it is due to update need to be done in software center.	SOLVED
4.	S.GNANADESIGAN Executive (Production Chemistry)	SKG	GPE/ PCHEM	Suggest to develop the impact of chemical compatibility or side products from each product from DPT with respect to fluid property.	Team agreed that chemicals compatibility is a compulsory testing after the demulsifier formulation The compatibility has been developed and tested.	SOLVED
5.	DINESH BALAKRISHNAN Executive (Production Chemistry)	SKO	Baronia	To revise the sampling date to actual sampling date, not the date of inserting the data into the tool	Team agreed to add on date of sampling option in the tool. The enhancement request already submitted to software developer.	SOLVED
6.	WIDYARATIH HAFIZAH MECHOR Executive (Production Chemistry)	SBA	Samarang	1. To change the application tool name to iPrEST+DPT 2. There is a minor bug on the case missing after run export all to excel 3. To update user manual & excel export to also include DPT application 4. To add unit display in the column for the result 5. If possibility to add the acceptance criteria based on the probability calculation	1. Done. Already updated in Tech Apps. 2. DPT option for export to excel is still unavailable. Team will proceed to enhance the DPT tool as PrEST. 3. As of item #2 4. Noted, for DPT result just need to add cloud point unit (degC). 5. Done updated in the manual. Acceptance criteria is based on the working base demulsifier referring to the first four highest probabilistic (>0.5 probability).	SOLVED

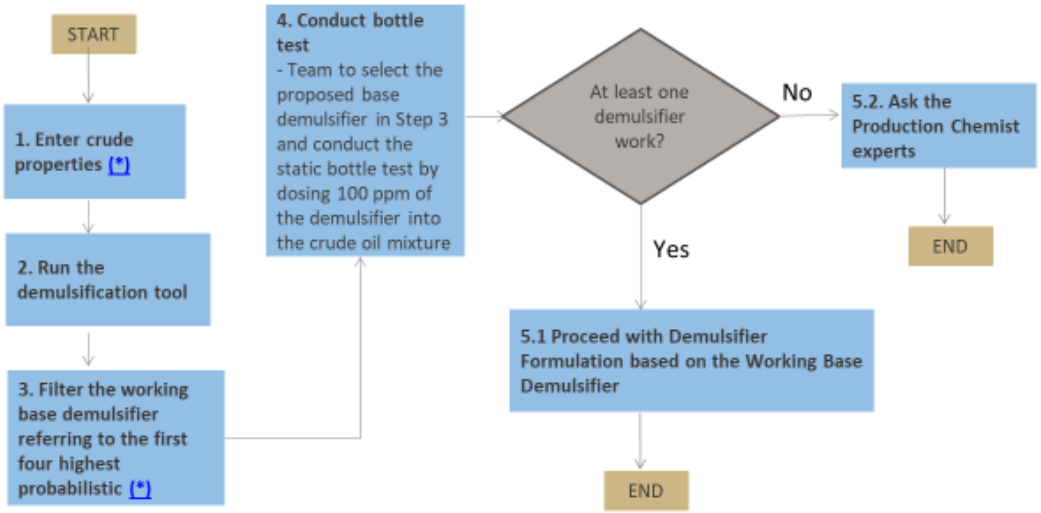
PrEST post TRL7: Software Enhancement #1



Non EOR excel template:
To remove EOR input parameters -'Water Cut' and 'Surfactant'

DPT TRL 7 : Software Enhancement #2

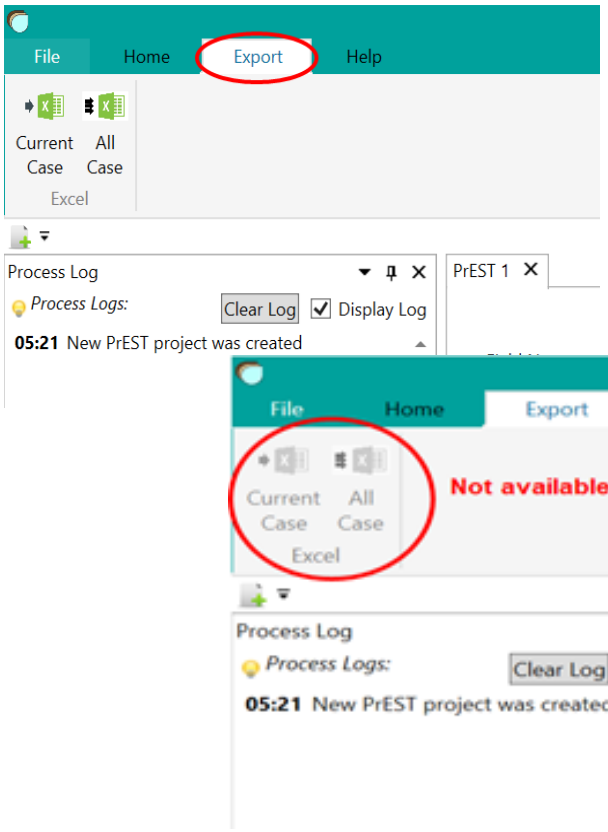
Demulsification Tool Application Workflow

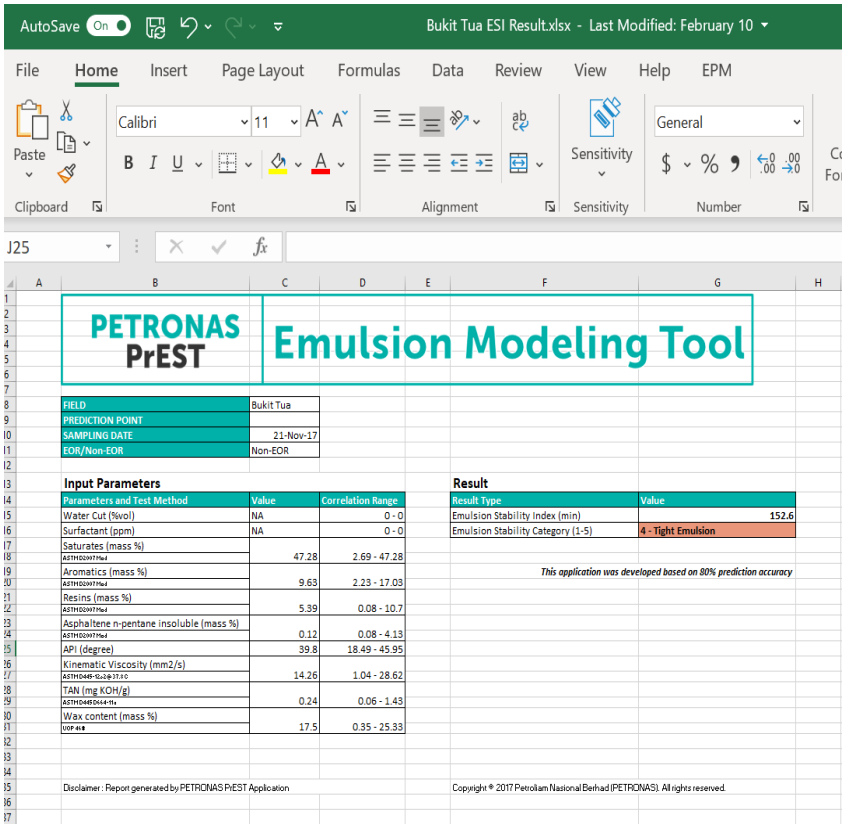


Temperature	API	Asphaltene	Solid	Wax	Demulsifier Type	RSN	MW	Cloud Point	Working	Probability
35	26	1.9	0.02	5.5	Resin Alkoxylate	11	5000 - 10000	54	Yes	0.91
35	26	1.9	0.02	5.5	Polyol alkoxylate	11	10000 - 50000	69	No	0.23
35	26	1.9	0.02	5.5	Resin Alkoxylate	15	< 5000	68	No	0.08
35	26	1.9	0.02	5.5	Resin Alkoxylate	16	< 5000	49	Yes	0.71
35	26	1.9	0.02	5.5	Resin Alkoxylate	16	5000 - 10000	53	Yes	0.78
35	26	1.9	0.02	5.5	Resin Alkoxylate	17	5000 - 10000	58	Yes	0.58
35	26	1.9	0.02	5.5	Polysorbate polyester	17	10000 - 50000	60	Yes	0.67
35	26	1.9	0.02	5.5	Resin Alkoxylate	17	5000 - 10000	50	No	0.49
35	26	1.9	0.02	5.5	Polyol alkoxylate	17	5000 - 10000	87	No	0.42
35	26	1.9	0.02	5.5	Resin Alkoxylate	19	< 5000	50	Yes	0.69
35	26	1.9	0.02	5.5	Resin Alkoxylate	19	< 5000	79	Yes	0.53
35	26	1.9	0.02	5.5	Resin Alkoxylate	20	< 5000	72	No	0.43
35	26	1.9	0.02	5.5	Polyol alkoxylate	20	5000 - 10000	67	Yes	0.78
35	26	1.9	0.02	5.5	Polyol alkoxylate	20	5000 - 10000	79	Yes	0.67
35	26	1.9	0.02	5.5	Resin Alkoxylate	21	< 5000	74	No	0.37
35	26	1.9	0.02	5.5	Resin Alkoxylate	21	< 5000	60	Yes	0.72
35	26	1.9	0.02	5.5	Resin Alkoxylate	21	< 5000	64	Yes	0.51
35	26	1.9	0.02	5.5	Polyimine derivative	6	10000 - 50000	34	Yes	0.83
35	26	1.9	0.02	5.5	Polyimine derivative	7	> 50000	13	Yes	0.75
35	26	1.9	0.02	5.5	Polyimine derivative	9	10000 - 50000	9	Yes	0.67
35	26	1.9	0.02	5.5	Polyimine derivative	10	> 50000	50	No	0.44
35	26	1.9	0.02	5.5	Polyimine derivative	11	> 50000	50	No	0.47
35	26	1.9	0.02	5.5	Polyimine derivative	16	> 50000	64	No	0.42

Based on the workflow #3 above, TRLC recommended team to highlight the first four highest probabilistic as per example below (blue boxes manually added for presentation pack purposes, recommendation for tool to automatically highlight the first 4 highest based on probabilistic no).

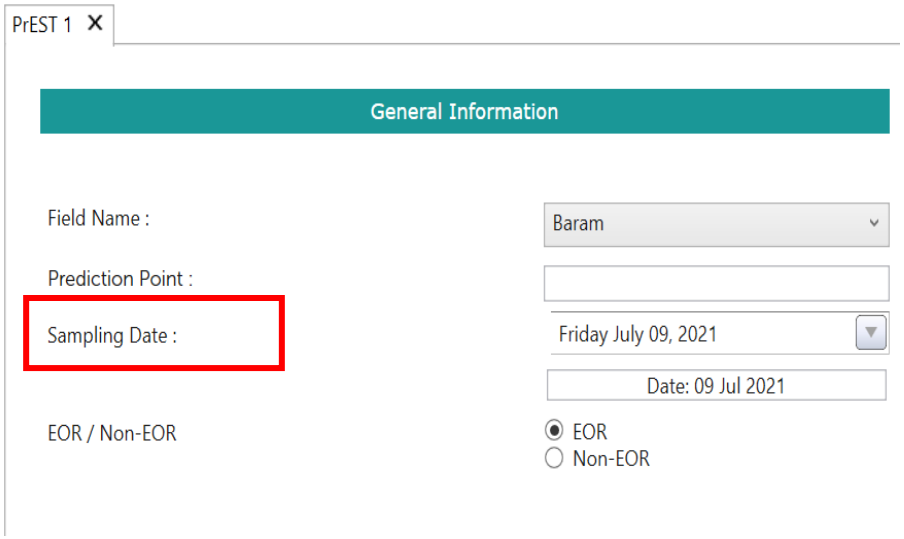
DPT TRL 7 : Software Enhancement #3

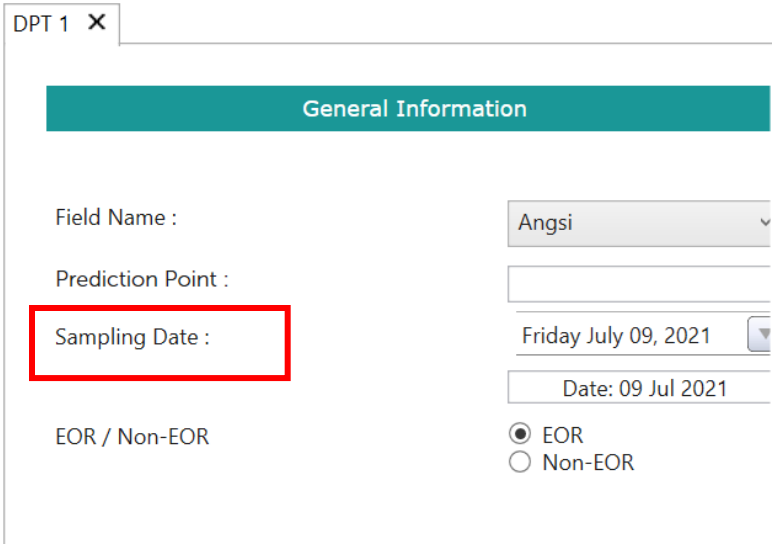




Export to excel file:
As per PrEST tool function, DPT also need to enhance its capability to export the result to excel file as above.

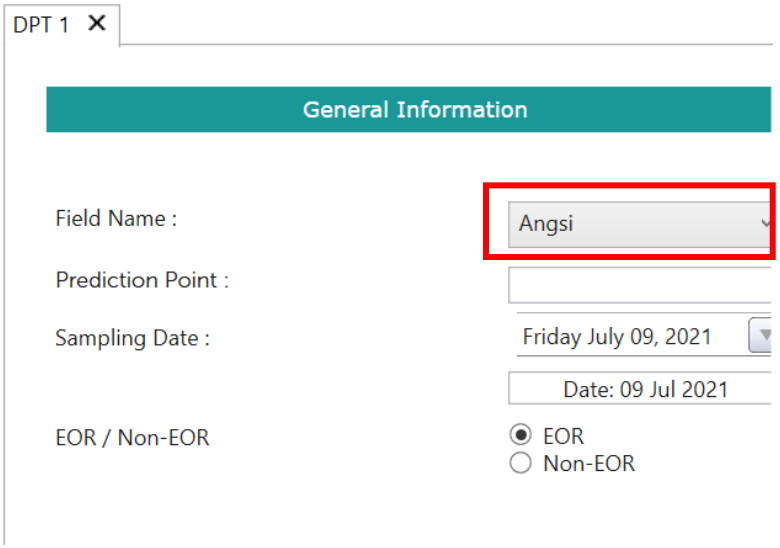
PrEST+DPT TRL 7 : Software Enhancement #4





Sampling date:
To change from ‘Sampling date’ to ‘Prediction date’ for both, PrEST and DPT

PrEST+DPT TRL 7 : Software Enhancement #5



Option for under ‘Field Name’:
To add ‘Others’ under field name for DPT

Thank you