SAGA REPORT No. 12

August 12th, 2019, an **IDDP-2 Flow Test Kick-off Meeting** was conducted in Reykjavik with 23 participants from HS Orka (HS), Landsvirkjun (LV), Orkustofnun (OS), Reykjavik Energy (OR), Equinor (EQ), ÍSOR, University of Iceland (UI), Kemia and GEORG. The Agenda and a list of participants is appended to this report. The IDDP-2 well is a part of the DEEPEGS Demonstration Site at Reykjanes.

The purpose of the meeting was to provide an overview on the IDDP-2 flow test preparation to enable the IDDP funding partners (HS, LV, OR, OS, EQ) to discuss and influence the final preparation. Guðmundur Ó. Friðleifsson, the IDDP PI and DEEPEGS coordinator, and HS chief geologist, opened the meeting by discussing the agenda followed by a brief overview on the IDDP-2 research progress since the time of drilling. Quite a few papers on IDDP-2 have already been submitted to the WGC-2020, meeting the end of July 2019 deadline. Part of important details from these papers were introduced, concerning the IDDP-2 condition, such as the casing damage (determined by well logging), connection to the surrounding well field (from fluid chemistry), and the apparent bottom hole temperature and fluid compositions (based on petrology and fluid inclusion data), as well as a short briefing on the funding issues. According to the current work schedule the flow test is expected to begin in September.

The 2nd presentation was made by Geir Þórólfsson, mechanical engineering manager at HS, who discussed the status of the surface equipment and the flow line design details. The details of the flow line design will be described in by Þorleikur Jóhannesson et al. at the WGC-2020 conference in April 2020. According to schedule the surface equipment should be ready for the flow test by early September.

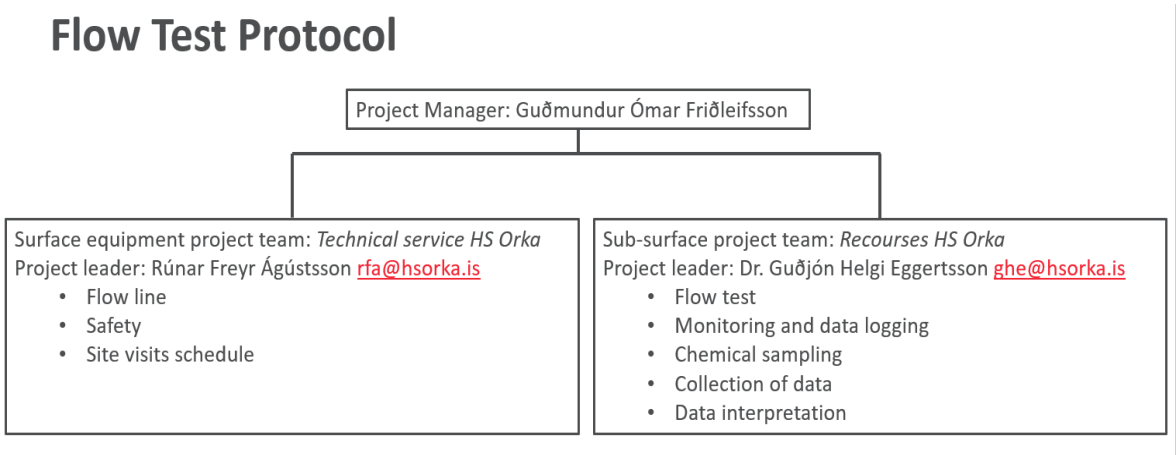
The 3rd presentation was on the on-site risk assessment by Rúnar F. Ágústsson at HS who briefed the meeting on the HazOp report already published to the team by the Verkís consultants, but mostly focused on a new in-house risk assessment report done and conducted by HS Orka team on environmental health and safety issues on the IDDP-2 test site. RFÁ briefed the meeting on this report.

The 4th presentation was then done by Sturla Sæther from Equinor, on the expected IDDP-2 flow performance from the different feed zones within the well and their P-T conditions and injectivity indexes. According to SS the expected contribution from the different feeds will much depend on the flow rate from the well. The lower the flow rate the higher the contribution from the supercritical bottom feeds. GOF had earlier (1st presentation) briefed the meeting on likely temperature and fluid composition in the bottom feeds based on Enikö Bali's fluid inclusion data, which indicate that the temperature there is close to 600°C and the fluid composed of H_2O rich vapor and Fe-K-Cl rich brine with high Cu concentration (>1 wt%). The question remains, as discussed later during the meeting, if the contribution from the supercritical vapor will be

sufficiently high to heat the upper feed zone at 3.4 km to produce superheated steam. Due to the casing damage at 2.3-2.4 km (which will involve leak-out from the well according to SS's evaluation) and evidently the current condition of the well near the bottom, the fluid compositions at different flow rates may be a challenging task to interpret.

The 5th presentation was given by Ómar Sigurðsson, HS reservoir engineer, discussing the flow initiation based on his new report on "Initiating discharge from the IDDP-2 well". A mobile air compressor will be used to assist in initiating the discharge. The compressor has a pressure limit around 42 bars and can compress the liquid level down by 350-400 m for heating where the main heating will be by the inflow at the casing damage. Assuming 3-5 L/s inflow at the damage zone, it would take the inflow about 1-1.5 hours to expel the liquid in a 400 m column. Therefore, the warmup time for the compressed liquid column will be short. However, the initiation sequence may need to be repeated several times before the well starts to flow naturally, so this stimulation of flow may take a week or two for completion. If this effort is not sufficient to initiate the flow, a plan B and C were briefly discussed in the discussion session that followed ÓS's presentation.

The 6th and final presentation on the flow test was given by Guðjón H. Eggertsson, geologist at HS, who briefed the meeting on how the flow test is to be operated. The flow test is planned according to the most likely scenario based on the current knowledge of the well condition but will be adjusted as needed once running. The main emphasis during the flow test will be safety, with the aim of never having to close the well. Data will be collected from electric sensors and regularly checked against mechanical gauges. Well head pressure (WHP), critical pressure Pc, and water level in weir box will be monitored, visual inspection and readings made regularly, control valve (Elli valve) adjusted as needed and chemical sampling done and analyzed, and results logged and presented. GHE then continued by briefing the meeting on the chemical sampling. The plan presented assumes conductivity and pH will be monitored 3 times a week (from week 1), SiO_2, Fe and suspended solids twice a month (from week 2), XRD and SEM once a month (from week 4) and full chemical sampling once a month (from week 4). GHE concluded by showing a management diagram which he called:



The chemical sampling plan was then discussed in some details where a lesson learned from the IDDP-1 flow test in Krafla was repeatedly referred to. The meeting concluded that a recommendation from a group of fluid chemists from the IDDP funding partners should be made and discussed with the HS onsite team.

After a lively discussion and a short break, the kick-off meeting continued into a "brain storming session" on potential on-site tests of materials and fluids during the flow- and pilot tests – that is desirable add-on-tests not yet planned or funded. Ingólfur Ö. Þorbjörnsson, head of ISOR's Geothermal Engineering, started by discussing desirable material test to be conducted in a container and an autoclave originally funded and used in the H2020 supported Geowell project. To continue by doing similar tests on the IDDP-2 fluid would be most desirable and apparently doable at a relatively low cost in the autoclave already available. Sigrún N. Karlsdóttir, professor in Mechanical Engineering at the University of Iceland, described tests that her group on Corrosion and Materials had conducted earlier on IDDP-1 in Krafla. Similar testing would be most desirable on the IDDP-2 well, with methods including: mechanical, microstructural and chemical composition analysis, visual inspection, optical microscopy, SEM/EDS, XRD, weight loss analysis, stressed specimens for inspection to EIC susceptibility, comparison with laboratory testing at superheated conditions, and follow up with changing parameters in HTHP autoclave in the UI laboratory. Trausti Hauksson, manager and owner of Kemia, concluded the session by describing the initial idea made by an IDDP chemistry group many years ago, to develop and build an autoclave for fluid testing directly from the IDDP-2 well on site. He concluded by discussing a test set-up he had already described at the WGC-2015 in Melbourne, Australia, something that could now be realized at the IDDP-2 well site. The kick-off meeting concluded by recommending IÖÞ, SNK and TH to formulate the desired tests in detail and seek funding to set them up at the IDDP-2 site. SNK informed us that she already had some funds to continue her effort.

IDDP Deep Vision steering meeting

An IDDP Deep Vision (DV) steering committee meeting was conducted the following day, discussing the results and impact of the IDDP-2 flow test kick-off meeting. A decision was made to follow-up by setting up and nominate candidates for five groups to monitor the IDDP-2 flow test: 1) An Oversight Committee (by DV representative). 2) A Chemistry Group (with nominees from EQ, HS, LV, OR, ISOR), to recommend and watch the fluid chemistry. 3) A Reservoir Engineering Group (with nominees from the same and consulting engineers) to recommend and watch the reservoir behavior. 4) A Pilot Test Group (with nominees from the same and consulting engineers), to begin preparing a pilot test for power production, and 5) Add-on Test Group (with nominees from ISOR, UI, Kemia). GOF was to liaise with all groups, organize meetings and report to the oversight committee. A meeting in group 2 was set up the following day and formal recommendation sent to GHE at HS for consideration.

Appendix

	IDDP-2 FLOW TEST	Date / time			
	Kick-Off Meeting		speaker:		
	AGENDA:	12. August 2019			
1	Opening	13:15 - 13:30	GÓF		
2	Preparation - Status - design	13:30 - 14:00	GÞ		
3	On Site Risk Assessment	14:00 - 14.30	RFÁ	MÓH	
4	What do we expect ?	14:30 - 15:00	SS		
5	Flow Initiation	15:00 - 15:15	ÓS		
	Coffee break	15:15 - 15:30			
6	Fuid Sampling and Running	15:30 - 16:00	GHE		
7	Other tests/materials-fluids	16:00 - 16:45	IÖÞ	SNK	TH
	Discussion	16:45 - 17:00			

	List of participants:		
1	Albert Albertsson	HS Orka	AA
2	Hildigunnur H. Thorsteinsson	OR	HHTH
3	Jónas Ketilsson	OS	JK
4	Sturla Sæther	Equinor	SS
5	Carsten Sörlie	Equinor	CS
6	Guðmundur Ó. Friðleifsson	HS Orka	GÓF
7	Geir Þórólfsson	HS Orka	GÞ
8	Guðjón Helgi Eggertsson	HS Orka	GHE
9	Ómar Sigurðsson	HS Orka	ÓS
10	Rúnar Freyr Ágústsson	HS Orka	RFÁ
11	Sigurður H. Markússon	LV	SHM
12	Ásgerður K. Sigurðardóttir	LV	ÁKS
13	Ingvi Gunnarsson	OR	IG
14	Gunnar Gunnarsson	OR	GG
15	Pálmar Sigurðsson	OR	PS
16	Steinþór Níelsson	ISOR	SN
17	Finnbogi Óskarsson	ISOR	FÓ
18	Ingólfur Örn Þorbjörnsson	ISOR	IÖÞ
19	Sigrún Nanna Karlsdóttir	HÍ	SNK
20	Andri Ísak Þórhallsson	HÍ	AÞ
21	Enikö Bali	HÍ	EB
22	Trausti Hauksson	Kemia	TH
23	Sigurður G. Borgason	GEORG	SGB