Technology Qualification Plan Statement of Endorsement

Office: **Lloyd's Register Consulting - Energy AS**
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Norway

Date: **13 May 2019** Endorsement Expiry Date: **13 May 2020**

LR Reference **PRJ1109997373**

This statement is issued to Swedish Stirling AB in recognition of the Technology Qualification Plan developed for the PWR BLOK 400-F environmental impact.

CLIENT: Swedish Stirling AB
PROJECT: PWR BLOK 400-F
SUBJECT: Endorsement of Technology Qualification Plan Submitted to LR by Swedish Stirling AB
Technical Review: David Tveiten and Johan Fagerlund
Technology Qualification Review: Anne Hegle

Statement of Endorsement:

On 10th April 2019 a Technology Assessment workshop was held at Swedish Stirling's premises in Gothenburg, Sweden, following which a Technology Assessment Report [2] was issued to Swedish Sitirling. Subsequently the Technology Qualification Plan [3] was submitted to LR by Swedish Stirling on 13th May 2019. The scope of the TQ was the environmental benefits of implementation of PWR BLOK 400-F in a ferrochrome facility in South Africa.

Swedish Stirling's TQ Plan [3] has been evaluated against LR Technology Qualification Guidance Note 2017, Step 1: Technology Appraisal [1]. This is part of LR's TQ Process Stage 2: TQ Plan and Stage 2.1: LR TQ Statement. Throughout this process no major technological/process limitations were identified that renders the technology/process unfeasible. Lloyd's Register takes the view that upon successful completion of the technology/process qualification activities identified in the TQ Plan [3], the technology/process would be mature for implementation in the operating environment and may achieve the desired outcome.

This statement must be read together with the Lloyd's Register Technology Assessment Report [2]. See notes (3) and (4) below.

(1) Brief Overview of Technology/process

PWR BLOK 400-F is a container-based solution in which Swedish Stirling's Stirling engine technology is used to harness energy from industrial residual gas combustion. The container(s) is placed at facilities where combustion of residual gases occurs and converts the heat in the residual gas to clean electricity.

(2) Technology Goals

1: Reduction of carbon emissions in South Africa by 3500 tons/year.
2: LCoE at 19.5 EUR/MWh.
3: Determine CO_2 reduction pr. invested EUR.

(3) Technology Qualification Boundaries	Lloyd's Register carried out Technology Qualification Stage 1 (Technology Appraisal) of the PWR BLOK 400-F. The TQ plan is endorsed for the reduction of uncertainty related to environmental benefit of implementation of PWR BLOK 400-F in a ferrochrome facility in South Africa, which was addressed in the workshop.
(4) Lloyd's Register Scope of Review	Lloyd's Register has evaluated the technological challenges and uncertainties within the technology qualification boundary (3) as reported in [2]. LR has reviewed the qualification plan developed by Swedish Stirling in [3] which contains a range of qualification activities to mitigate against the technological uncertainties identified in [2]. LR Technology Qualification methodology evaluates the technological/process uncertainties. It must be noted that its purpose is to mitigate against the technological uncertainty posed by the technology/process.
(5) Change Management	Any major changes to the TQ plan [3] or the qualification activities which may change the Technology goals and their objectives must be captured in additional revisions of the TQ plan and is subject to approval by LR. Failure to follow this change management process will invalidate this statement.
(6) Reference Documents	[1] Guidance for Technology Qualification, Lloyd's Register, May 2017 [2] Technology Appraisal Report, Lloyd's Register - Technology Qualification PWR BLOK, Final, 26.04.2019 [3] Swedish Stirling: Technology Qualification Plan for PWR BLOK 400-F, Doc.no. RE-2019-xxx, Rev. PA1, Approved 13 May 2019

Prepared By	Approved By
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