

**IMPORTANT NOTICE TO PRE-QUALIFIED BIDDERS FOR TRANSMISSION-CONNECTED
LARGE SCALE SOLAR PHOTOVOLTAIC PLANT**

POWER SYSTEM STUDY (PSS) REQUIREMENT FOR RFP SUBMISSION

Reference is made to the “**Guidelines on Large Scale Solar Photovoltaic Plant for Connection to Electricity Networks**”, which was uploaded on 4th May 2016.

Suruhanjaya Tenaga (ST) wishes to clarify to Bidders for **Package P3 (30MW to 50MW)**, with respect to Power System Study (PSS) as described in Appendix C: Technical Specification for Transmission-Connected LSS, Chapter 4 (PSS), as follows:

1. PSS Stage 1

- i. PSS using “**generic**” modelling of the Facility is mainly to verify the impact of LSS on the existing Grid System, which can be analyzed based on relevant information of the Facility already known at that point of time.
- ii. The study’s scope is explained in greater details in the Guidelines for PSS Stage 1 issued by Grid Owner as per **Attachment 1**. In summary the analysis shall include **Steady State Study** and **Transient Stability Analysis**.
- iii. The report shall be valid for **three (3) years** subjected to conditions stipulated in the Appendix C of ST’s Guidelines on LSS PV Plant for Connection to Electricity Networks (see Paragraph 4.6).

2. Package P3 Bidders with Proposed Capacity of 50MW

- i. Bidders shall perform PSS Stage 1 as per item 1 above.
- ii. The final report (approved by Grid Owner) of PSS Stage 1 shall be submitted along with the RFP submission.

3. Package P3 Bidders with Proposed Capacity Less Than 50MW (<50MW)

- i. Bidders shall perform PSS Stage 1 **Steady State Study** while **Transient Stability Analysis** is **optional**, at this stage.

- ii. However, Bidders are reminded that any risk and its associated costs which are not identified at this stage in the absence of **Transient Stability Analysis** shall be solely borne by the Bidders. **NO TARIFF ADJUSTMENT** will be allowed.

4. All PSS Stage 1 report shall be submitted to Grid Owner no later than **30th August 2016**.

5. PSS Stage 2

- i. PSS using "**the actual**" model of the Facility and interconnector will need to be study in greater details based on the design and technology used.
- ii. PSS Stage 2 shall be performed by **all successful bidders**.
- iii. The study's scope is explained in greater details in the Appendix C of ST's Guidelines on LSS PV Plant for Connection to Electricity Networks (see Chapter 4). In summary the analysis shall include **Steady State Study** and **Transient Stability Analysis**.
- iv. The final report of PSS Stage 2 shall be submitted to Grid Owner for approval no later than sixty (60) days prior to the Commercial Operation Date (COD).

Bidders shall take note that:

- i. Full compliance with Malaysian Grid Code (MGC) and Transmission System Reliability Standards (TSRS) is mandatory as stated in RFP Part 3, Clause 4.8.3 and 4.8.4; and
- ii. Bids that do not conform to the requirements of this RFP are not acceptable and any such Bids received by ST will be rejected. **No Conditional Bids** will be accepted, as stated in RFP Part 1, Clause 5.3.2.

Bidders are advised to engage relevant Consultants **immediately** in order to meet the RFP Closing Date, **23rd September 2016**, as late submissions will not be accepted. The list of prospective Consultants for Transmission Connected PSS is included in the **Attachment 2**. However, Bidders are allowed to appoint any qualified Consultants which may not be in the list.

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Email: lssp@st.gov.my

28th June 2016

Guidelines for Power System Study (PSS)

(Stage 1)

Note :

This document provide brief guidelines for performing the PSS and outline the content of report to be submitted for approval.

**Grid Owner
23 June 2016**

- 1 Objectives of PSS**
- 2 Case & Scenario of PSS**
- 3 Power flow Analysis**
- 4 Transient Stability Analysis**
- 5 Topics to be included in PSS report (minimum requirement)**
- 6 System Data – Requirement for Non Disclosure Agreement**
- 7 PSS Approval Process**
- 8 Timeline**

Power System Study (PSS) is to be carried out by the LSS PV plant Developer



- **Objectives of the PSS are:**
 - To identify connection scheme options (and configurations) for the Transmission-connected LSS PV plants to be connected to Grid System, taking into account the existing transmission infrastructure within the vicinity of the plant.
 - To investigate the impact of the new interconnection to the Grid System as well as the impact of the Grid System to the operations of the LSS PV plants.
 - To assess the ability of the grid-connected LSS PV plants to comply with the technical requirements as stated in the Grid Code/ PPA
- **Documents for reference / benchmark for compliance**
 - Malaysian Grid Codes (Version 2015)
 - Transmission System Reliability Standards (Referred to as License Standards by MGC)
 - Draft PPA (as included in the RFP documentation provided by ST)

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Two snapshots of load levels are to be studied

- **Year 2018 or 2019 is to be studied**
 - **The selected year is to reflect the year which the LSSPV plant will be commissioned**
- **Two snapshot of load levels**
 - **Peak load of the year**
 - **Light load (about 70% of peak load)**

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PSS : Scope of studies to be included in the steady state assessment (1)



- **Steady state studies and analysis**

- **Power flow study to identify the capacity for the grid connection and impact to the grid system**
 - During normal grid condition and under contingencies
 - The analysis is to be carried out for all the grid connection options
 - To carry out analysis for both peak and light load conditions
- **To assess voltage performance (within LSS development and at PCC)**
 - During normal grid condition and under contingencies
 - At different solar PV module operation
 - All modules in operation (100% power output)
 - Part of modules in operation (50% power output)
 - All modules not in operation (Zero output)
 - To carry out analysis for both peak and light load conditions
 - To identify compensation required (if any) to meet the reactive power requirement

PSS : Scope of studies to be included in the steady state assessment (2)



- **Steady state studies and analysis (continued)**
 - **Fault Level / Short circuit studies**
 - Identification of fault current contribution by the solar farm to the grid
 - To ascertain the fault level at grid connection point and within the solar facilities are within the short circuit rating
 - Type of fault: Single & Three-phase fault
 - To identify/ propose mitigation options for violation of criteria (if any)
- **List of contingencies to be applied**
 - **N-1 & N-2 of transmission elements**
 - Overhead lines
 - Underground cables
 - Transformers

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Scope of studies to be included in the stability/dynamic assessment (1)



- **Main objectives**
 - To assess the impact of LSS PV plants to the grid system and identify potential issues & mitigation options, in particular at the proposed grid connection point
 - To verify the performance of LSS PV plants when subjected to various grid system conditions
- The analysis is to be carried out for all the grid connection options and for both peak and light load conditions
- List of contingencies to be applied
 - **Transient/Dynamic**
 - **Category B - Events resulting in loss of a single element ****
 - 3-phase fault with normal clearing (150ms) followed by B1,B2,B3
 - » Up to two buses away, where applicable

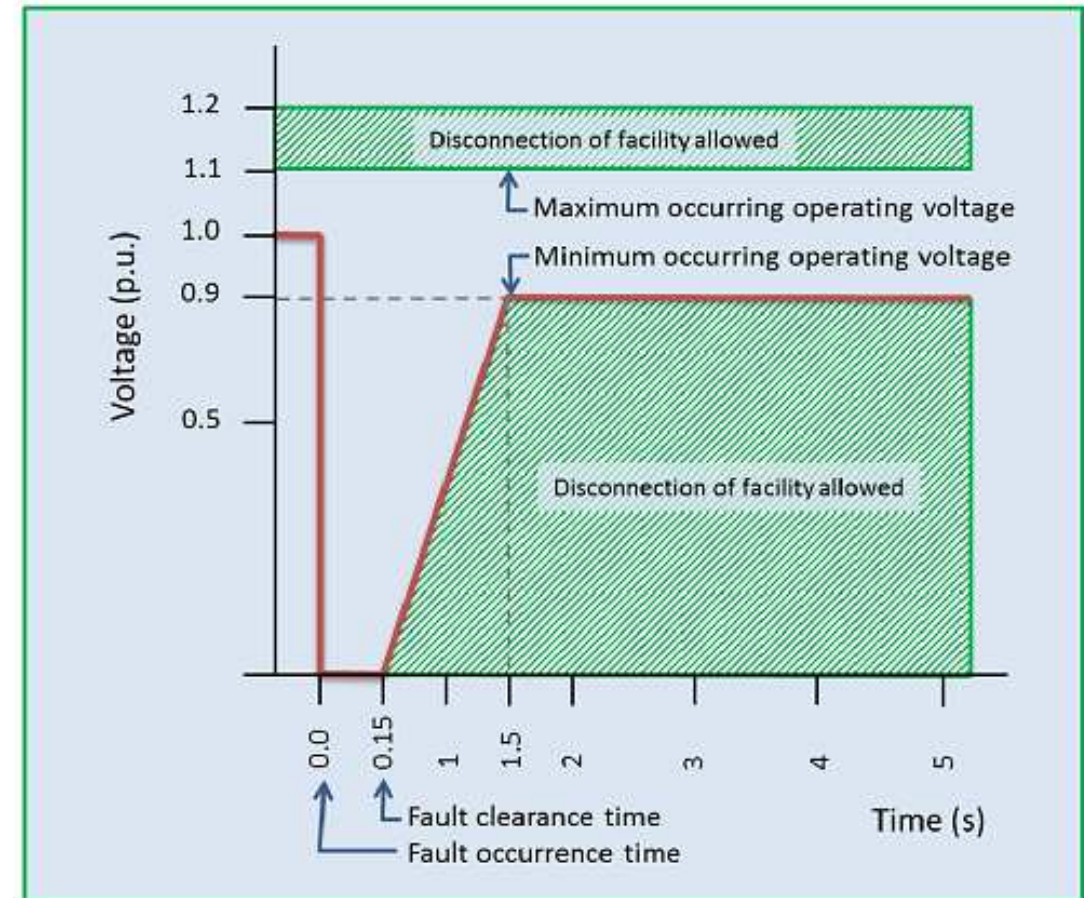
Scope of studies to be included in the stability/dynamic assessment (2)



- List of contingencies to be applied (continued)
 - Category C - Events resulting in loss of two or more elements **
 - One-phase fault with normal clearing (150ms) followed by simultaneous loss of two elements (B1,B2,B3) connected to the faulted bus
 - » Up to two buses away, where applicable
 - Three-phase fault with normal clearing (150ms) followed by simultaneous loss of two elements (B1,B2,B3) connected to the faulted bus
 - » Up to two buses away, where applicable

Scope of studies to be included in the stability/ dynamic assessment (3)

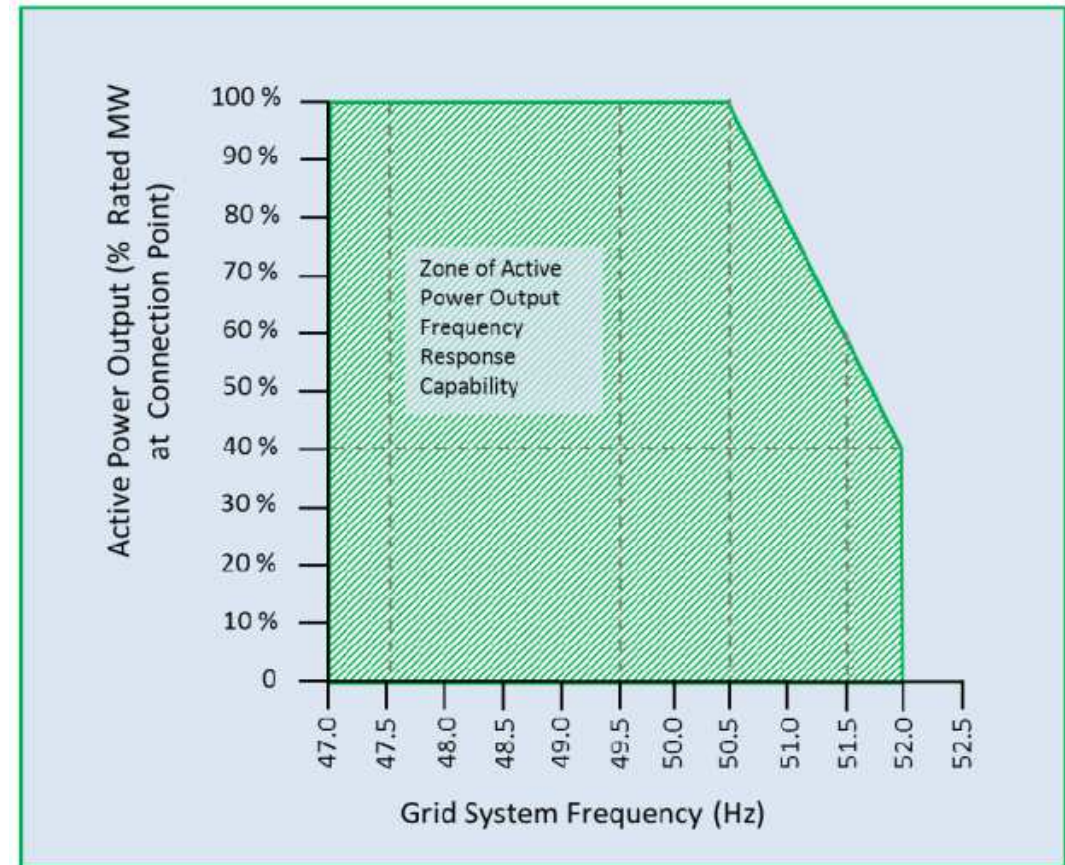
- **Fault / Low voltage ride-through capability**
 - To verify that with the connection of LSS at the proposed grid point, it will be able to remain in stable operation (without tripping) when subjected to fault in the grid system
 - The voltage pattern due to the fault is as shown in plot →.
 - One option to simulate the voltage condition is by varying the fault impedance
 - To monitor LSS power output (MW, MVar), voltage at PCC.



MGC - CC 6.4.15.2 (a)

Scope of studies to be included in the stability/ dynamic assessment (4)

- **Frequency response capability**
 - **To verify that the LSS will be able to maintain or reduce active power output (MW) when subjected to large frequency variation**
 - **The high/ low system frequency can be emulated through**
 - **Loss of large generation unit in the system**
 - **Loss of large load in the system**
 - **To monitor LSS active power output**



MGC - CC 6.4.2.3

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PSS report shall include critical information of the proposed LSS PV development



- Inception report is to be submitted soonest possible after the NDA signing to the Grid Owner for concurrence
 - List of contingencies to be carried is to be agreed before proceeding with PSS
- Information on the development with respect to:
 - Location of development
 - Map showing location (with GPS coordinates)
 - Proposed LSS PV plant information
 - Capacity to be installed
 - Type of solar panels / cell technology
 - Number of modules/string, inverters etc
 - Commercial Operation Date(s)
 - Full or partial commissioning dates

The proposed connections options are to be illustrated with appropriate single line diagrams



- **Information on the proposed point for grid connection**
 - **Existing substation / new substation**
 - **Name of existing substation**
 - **Location of new proposed substation (if applicable)**
 - **Whether it involve new transmission lines / underground cables**
 - **Approximate length of transmission lines / underground cable from LSS PV plant to grid connection point**
 - **Number of proposed feeder from LSS PV plant to existing/new substation where the grid connection will be made**
 - **Number and rating of transformer/s**

- **Information on the internal network within the development area**
 - **Single line diagram stating the internal network within the**
 - **Number of feeders/bays at the plants/units switchyard/substation**
 - **Solar panel arrangement/ topology**

Modelling and associated parameters of various components related to the plant and grid connection scheme are to be included in the report (1)



- **Steady state models and associated parameters are to be tabulated**
 - **Static representative of the LSS**
 - Inverters rating, impedance, etc
 - Use of equivalent system to model Solar Facilities is acceptable
 - **Step up transformers**
 - Rating
 - Winding voltage HV/LV
 - Tap changer range (nominal, high, low tap)
 - Impedance etc
 - **Grid Interfacing (lines or underground cables)**
 - Rating of the grid connection
 - Type of conductor used for the transmission lines
 - Type of underground cables for the grid connection
 - Associated parameters (RXB) for either one of the above

Modelling and associated parameters of various components related to the plant and grid connection scheme are to be included in the report (2)



- **Dynamics models and associated parameters used for stability studies are to be tabulated**
 - **As this stage, generic modelling is acceptable**
 - **Dynamic representation of the solar farm, which may include**
 - **PV panels**
 - **Inverters and associated time constant**
 - **Solar irradiation and associated time constant**
 - **Inverter controls with associated time constants**
 - **Response of inverter model is to be verified to ensure certain degree of accuracy**
 - **By comparing with expected/typical response**
 - **Consultant may want to refer to OEMs or based on available literature by others for the parameters to be used for the associated models**

Results of the analysis are to be tabulated and associated plots from the simulation are to be included



- **Among others the results of steady state analysis includes:**
 - **Comparison of parameters with and without LSS PV connected. Parameters to be compared are listed below. Only difference of more than 10% are to be listed**
 - **Bus voltage profiles**
 - **Transmission lines/cables/transformer loading profiles**
 - **Fault levels**
 - **List of contingencies and violations of criteria set up in the TSRS**
 - **Reactive power compensation requirement (if any)**
 - **Other evidence that indicate compliance to criteria (TSRS/ MGC)**
- **Results of transient analysis (with contingencies)**
 - **Bus voltage magnitude & frequency**
 - **MW & MVar flow on transmission lines/ cable connected to LSS PV plant**
 - **MW & MVar out put from the LSS PV plant**
 - **Evidence to indicate LSS PV plant ability to ride through fault without tripping the plant**

The report shall include the Summary, Conclusion and Recommendation of the PSS



- **The recommendation of the PSS**
 - **Scheme for the grid connection**
 - Point of connection
 - Voltage level
 - Number of transmission lines/ underground cable
- **Justification of the recommendations with respect to**
 - **Compliance to criteria**
 - **Impact to grid system**

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System Data for the PSS will be handed over to the appointed consultant upon signing of NDA (1)



- **Developer is to appoint Consultant for the PSS**
 - **Grid Owner require a formal notification through letter for the appointment before proceeding with the NDA**
 - **Consultant profile and associated CVs to be appended in the notification letter**
- **NDA is between Grid Owner and the appointed Consultant**
 - **Data will only released to the consultant**
- **Once formal letter from Developer is received, draft NDA will be sent to the appointed consultant for review.**
 - **If no disagreement to the clauses in the draft NDA, the Consultant is to print 2 copies, fill-up necessary information and initial on each page**
 - **Completed document is to be sent to Grid Owner for signing**
 - **Upon signing, document will be sent back to Consultant for stamping**
 - **One copy of the stamped NDA is to be returned to Grid Owner for the release of system data**

System Data for the PSS will be handed over to the appointed consultant upon signing of NDA (2)



- **Allow 2 weeks for process to complete (from return of NDA to Grid Owner)**
- **Data will be provided in PSS/E format version 32**
 - **Sav cases : peak and lower peak (70% of peak)**
 - **Dynamic data for existing plants (.dyr)**
 - **Dynamic link library (.dll)**
 - **Alternatively object codes for user models (.obj) will be provided upon request**

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All PSS results will be scrutinized by an Approval Committee within TNB



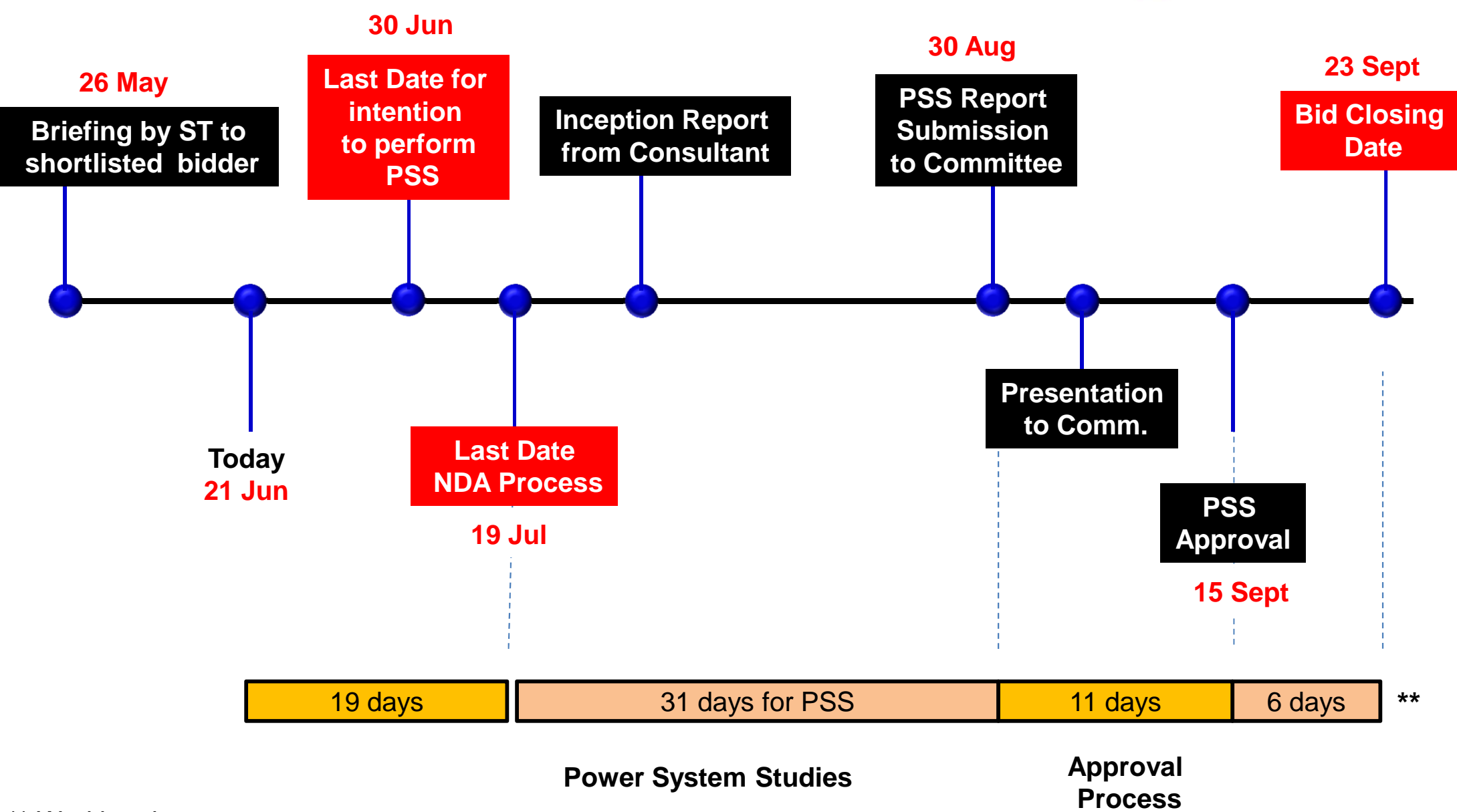
- **PSS reports are to be submitted at least 14 working days before the expected date of approval**
 - Report in form of presentation slides is accepted for the purpose of submission for approval
 - Full report is to be submitted by the date of bid submission (23 September 2016)
- **Consultant is to present the PSS results to the Committee for deliberation**
 - The Secretary to the Committee will set the date for the presentation of the report
 - Subsequently, letter of approval/disapproval will be issued by the Committee to the bidder
 - The Committee may request additional study to be carried out to ascertain certain results
 - Besides the connection scheme, the presentation slides should also focus on providing evidence that requirements has been achieved
- **Softcopy of study files used for PSS are to be submitted for verification purpose (if the need arise)**
 - Sav case & dynamic data (.dyr)

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Overview of timeline of the full PSS process



** Working days



ATTACHMENT 2: LIST OF PROSPECTIVE PSS CONSULTANTS FOR 30-50MW CONNECTION

NO.	COMPANY	COMPANY DETAILS	PERSON IN CHARGE
1	POWER SYSTEMS CONSULTANTS ASIA	100 TRAS STREET #16-01 THE AMARA CORPORATE TOWER SINGAPORE 079027	KEEHAN CHAN +65 9128 1830 keehan.chan@pscconsulting.com
2	LLOYD'S REGISTER	LEVEL 28, NAZA TOWER, PLATINUM PARK NO 10, PERSIARAN KLCC 50088 KUALA LUMPUR	STEVE LIAU 012-654 0076 steve.liau@lr-senergy.com
3	SMEC (MALAYSIA) SDN BHD	UNIT 509 BLOCK B PHILEO DAMANSARA 2 46350 PETALING JAYA T: 03-7955 0305 F: 03-7955 2110	MR. CHENG LEE 011-3325 0838 cheng.lee@smec.com IR. PUNITHA RAJAN DORAISAMY 012-211 0921 punitharajan.doraisamy@smec.com
4	MINCONSULT SDN BHD	LOT 6, JALAN 51A/223 46100 PETALING JAYA SELANGOR T: 03-7952 5757 F: 03-7954 7373 bizdev@minconsult.com	VIGNAESWARAN SHANMUGANATAN 03-7952 5668 vig@minconsult.com
5	SHER ENGINEERING & CONSULTANCY SDN BHD	C-03A-07, ITECH TOWER JALAN IMPACT CYBER 6 63000 CYBERJAYA, SELANGOR	OMAR ALI 012-6205099 omarali@sherengineering.com
6	ADVANCED POWER SOLUTIONS SDN BHD	UNIT 13G, LEVEL 7, BLOCK 1 WORLDWIDE BUSINESS CENTRE JALAN GINJU 13/50 40675 SHAH ALAM SELANGOR	MOHD ROSIDI BIN MOHAMED T: 03-5511 4800 F: 03-5511 4801 admin@aps-my.com
7	TNB ENERGY SERVICES	LEVEL 4 & 5 EAST WING, QUATTRO WEST BUILDING NO. 4, LORONG PERSIARAN BARAT 46000 PETALING JAYA SELANGOR T: 03-7662 5111 F: 03-7662 5112	MOHD NAJIB BIN MOHAMAD T: 016-3460743 E: najib.mohamad@tnb.com.my