Subject	GE comments on the consultation paper-amendments to the Power System Model Guidelines
From	GE Renewable Energy
To	AEMO PMSG Review
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In reference to the AEMO Consultation Paper published on 2 December 2022 on Amendments to the Power System Model Guidelines, GE's views on the consultation questions are following:

Consultation questions

12. Are there any other methods that could guarantee that models remain usable for the life of the plant despite changes to simulation tools, versions, or compiler toolchains that AEMO has not considered here?

[GE]: AEMO's main concern seems to be that models written using intrinsic PSCAD components/functions such as control (filter, integrators, etc) and circuits (R,L,C, transformer, machine, IGBT switch, etc) will not be exportable or compatible with other EMT platforms. Therefore just having an external DLL file which only consists of the control part of the model may not be the full solution to the problem. A better approach could be to avoid using intrinsic PSCAD components as much as possible as described below:

Model component	Current practice in the industry	Recommended approach
Control	No intrinsic PSCAD functions, plain Fortran code or C code	Plain Fortran code which can be easily exportable to other simulation tools
Circuit	all intrinsic PSCAD functions and models	No intrinsic PSCAD functions, plain Fortran code
Interface or wrapper	intrinsic PSCAD functions	intrinsic PSCAD functions
Compatibility in terms of different PSCAD versions and other EMT simulation tools	Less compatible (may not show same performance during transient if used on different/versions or tools)	Better compatibility

The above recommended PSCAD modelling approach overcomes the limitations of the induction generator and transformer models in the PSCAD standard model library. This modelling approach

allows to decouple the converter control signal estimations from the PSCAD network calculation time step. This approach is more advanced numerically than the explicit representation using library elements from PSCAD and has been discussed in several prior projects with AEMO and NSPs.

The electrical components modelled in the single black-box, including generator, converters, filter, and transformer, are running at a much faster rate (sub microsecond) than the rest of the power system model. It provides at least two apparent advantages: 1) reliable solutions of the electrical circuit than a typical 10 to 20 microsecond timestep used for feedback signals to converter control; 2) more precise converter gating action at a finer time stamp.

The ultra-fast rate of electrical circuit solution generates significant number of data points of the electrical quantities, e.g., volage and current and the model processes these "continuous-like" data points and sends them to the respective digital controllers at discrete rates. This approach closely approximates the analog to digital process in a real physical world and provides more accurate information than the typical approach of 10 to 20 microsecond PSCAD network solution to digital controllers.

Consultation questions

13. Would there be any issues with developing a DLL to conform with a standardised explicit linking routine?

[GE]: The DLLs in PSCAD might not always work with the new platform(s). Also, mention of "real code" in the guideline may be misinterpreted. The guidelines need to recognize that the model should be built based on **manufacturer-written code**, which could either be a direct replica of the controller firmware **or could be a close match**.