



Figure 1: The GOLEM tokamak remote control room layout. Basic engineering scheme of the tokamak combined with the web form enable setting up desired technology parameters to generate the plasma discharge. Left-top corner named "Vertical stabilization" represents the new level of the plasma scenario control.

The basic level of remote operation, see [Svoboda et al., 2011], gives remote participants a possibility to set up and submit basic tokamak technology parameters necessary to create plasma into a queue based system: power supplies for the toroidal magnetic field coil and the transformer primary coil, the pre-ionization tool and the injection system of the working gas via a web interface (see Fig. 1). After having checked the discharge set-up against safety and operational limits the control system processes the set-up and the results from basic diagnostics are presented instantly in a hypertext form of a shot homepage. Firing rate of one discharge per  $\sim$  minute is available, thus enabling systematic measurements, where participants can study the basic principles of tokamak technology, physics and operation, high temperature plasma diagnostics issues, breakdown studies, isotopic surveys, chamber conditioning examinations and can perform probe measurements, test various discharge scenarios, etc.

the tokamak GOLEM is mainly used for educational purposes it is extremely desirable to dive into the complexity of the tokamak control step by step, allowing participants to study the appropriate topics from the basic to the sophisticated levels. The current organization of the human-machine interface is organized as follows:

- Level "system check", with the purpose to test individual parts, where students can trigger toroidal magnetic field or toroidal electric field separately and observe their particular effect in the diagnostic system.
- Level "basic tokamak plasma", where the minimum technology required to control the tokamak is used to set-up the tokamak plasma: simultaneous trigger of the toroidal magnetic and electric field, while working gas and pre-ionization tool have been engaged in advance to the trigger.
- Level "vessel conditioning", where participants can study improved plasma performance regimes after vessel conditioning with the help of baking and glow discharge.

- Level " $E_t$ ,  $B_t$  orientation", where the influence of the mutual orientation of the toroidal magnetic as well as electric field on the plasma performance can be examined.

## References

- [Svoboda et al., 2011] Svoboda, V., Huang, B., Mlynar, J., Pokol, G., Stockel, J., and Vondrasek, G. (2011). Multi-mode Remote Participation on the GOLEM Tokamak. *Fusion Engineering and Design*, 86(6-8):1310–1314.