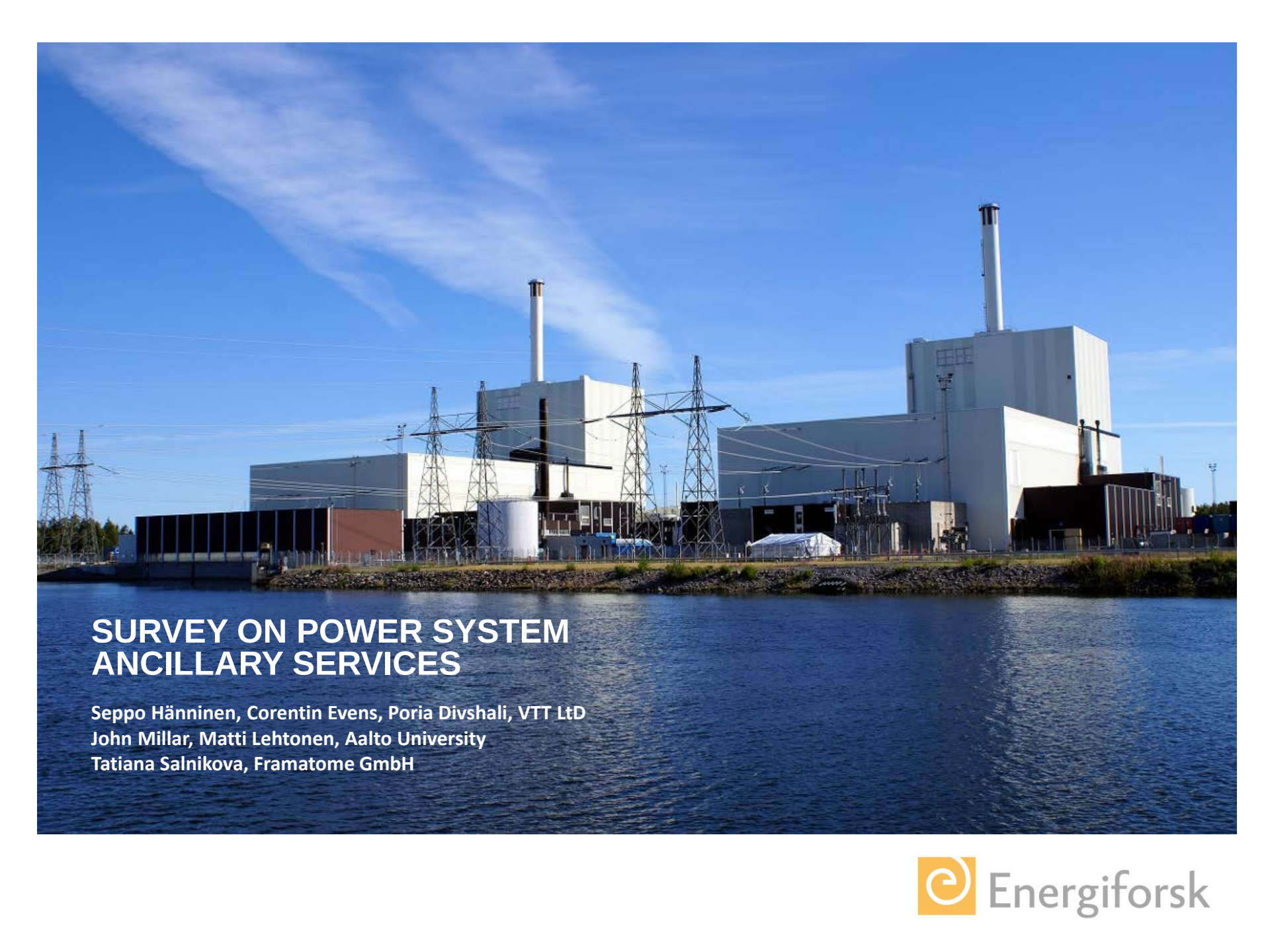




SURVEY ON POWER SYSTEM ANCILLARY SERVICES

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Scope

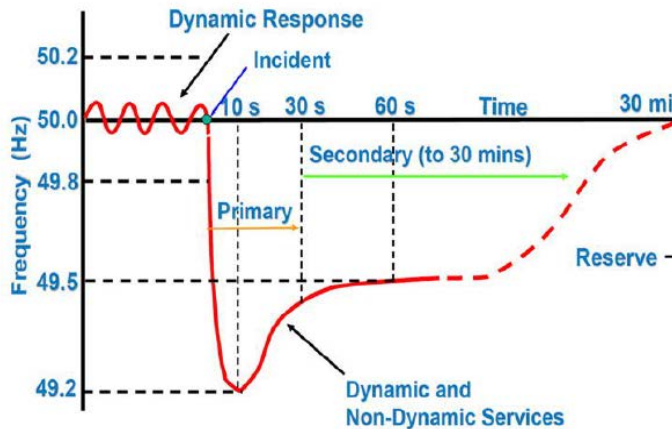
- A survey of how Australia, Ireland, UK and US Texas have set up their respective markets, regulations and ancillary products to ensure a stable power system.
- Power system challenges are similar to Sweden and Finland with increased amounts of intermittent production, nuclear reactors or other large system-important thermal production units.
- UK and US Texas have nuclear power plants running mostly on base-load operation. Flexible operation option has been analyzing. Electric Low Power Operation (ELPO) example in UK.
- Work based on literature survey and interviews of grid and nuclear area experts.
- Ancillary services provided by nuclear power plants in the Nordic grid context were proposed
- It is clear that flexible nuclear would be a great asset to the power system



Results/takeaways

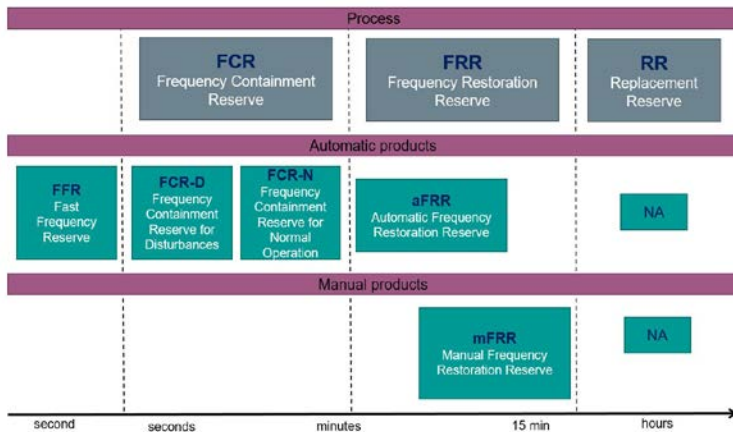
- The definition of Ancillary services depends on the physical characteristics of the power system
- Only very few ancillary services implemented in Australia, Ireland, UK and U.S Texas don't already have an equivalent and would be applicable in the Nordic system.
- They can however provide insights into the possible future needs of the Nordic system as well as a basis for solutions that could be implemented.
- Harmonization toward standard products and market integration of ancillary services are proceeding at EU level.
- Services such as voltage control and black start capacity and currently better served by regulations/grid codes or with bilateral contract during the installation of the refitting of individual units.

Mechanics of frequency control



Source: National Grid

Reserves products for frequency control in Finland



Source: Fingrid

Impact/conclusions

- New nuclear power plants (NPP) are technically able to provide various grid services, such as frequency and voltage control, if an adequate market design is established.
- The activation time for Fast Frequency Reserve product (FFR), though, is likely to be too fast for NPPs.
- Frequency Containment Reserve for Normal operation (FCR-N) is expected to be partly replaced by automatic Frequency Restoration Reserve (aFRR). With increased competition in the aFRR markets, they could become attractive for NPPs.
- FCR-D (Disturbance) reserve should be analyzed.
- Automatic and also manual Frequency Restoration Reserve (FRR) may be the best candidates for the ancillary services products provided by NPPs.