



**Survey on power system
ancillary services**

VTT

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framatome

**Energiforsk Webinarium
GINO project findings
13 October 2020**

15/10/2020 VTT – beyond the obvious

Scope

The logo for VTT (VTT Technical Research Centre of Finland) is located in the top right corner. It consists of the letters 'VTT' in a white, bold, sans-serif font, centered within a solid orange square.

- 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 analyzed. Electric Low Power Operation (ELPO) example in UK.
- Ancillary services provided by nuclear power plants in the Nordic grid context were proposed
- Work based on literature survey and interviews of grid, markets and nuclear area experts.

Project tasks

	Task 1.	Management	VTT
	Task 2.	Markets for ancillary services	VTT
Grid related tasks, (Aalto)	Task 3	Ancillary services required through Grid codes	Aalto
	Task 4	Ancillary services secured through individual contracts between TSO and IPP	VTT
Implementation task (Framatome)	Task 5	Forced operation from TSO	Aalto
	Task 6	Flexibility due to energy prices	VTT
	Task 7	Evaluation and applicability in the Nordic grid context and EU policy for future ancillary services	Aalto
	Task 8	Markets and services technically suitable and applicable to NPPs	Framatome
	Task 9	Reporting	VTT, Aalto, Framatome

Market related tasks (VTT)

SURVEY ON POWER SYSTEM ANCILLARY SERVICES



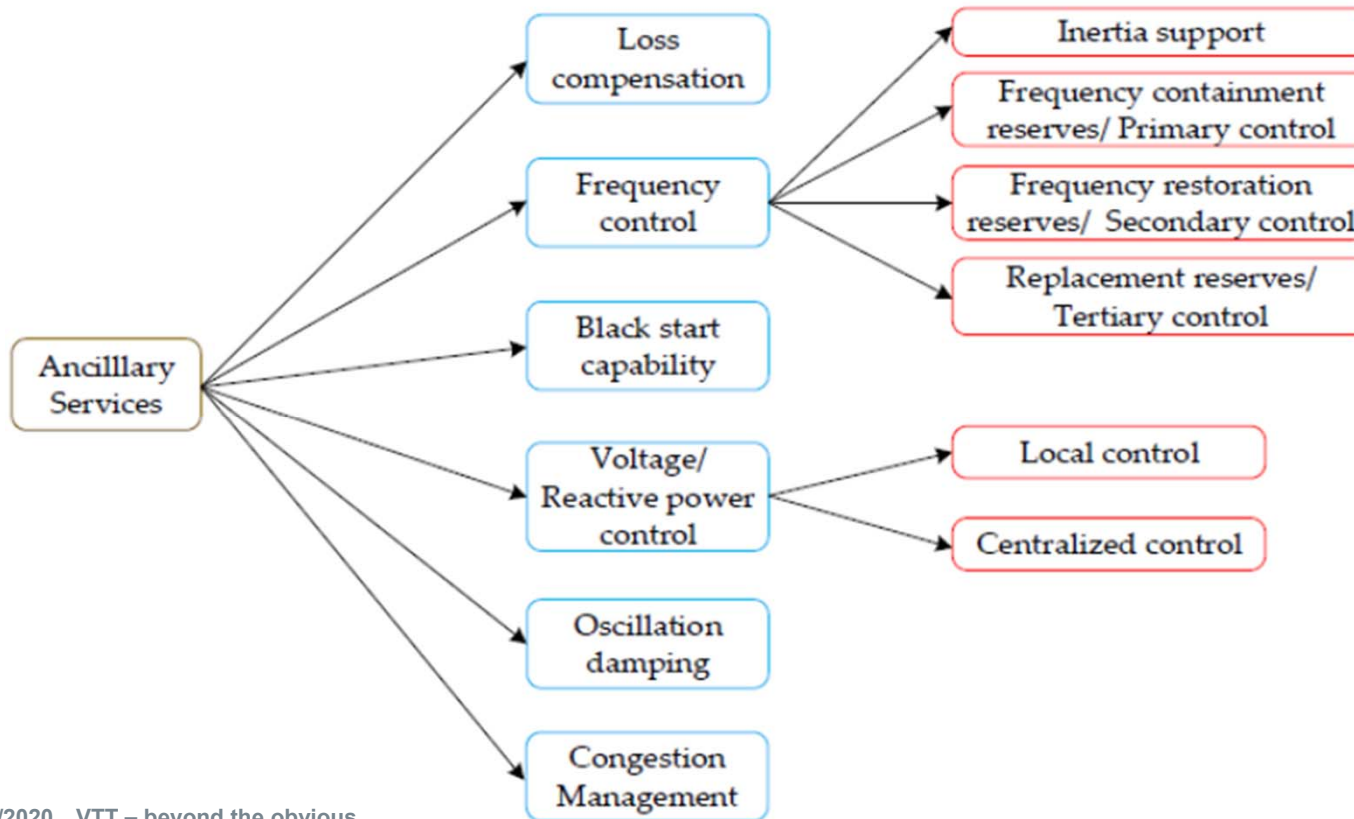
Draft Energiforsk report

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Draft report 89 p. + Annex 10 p.

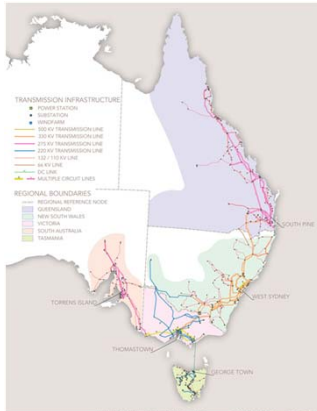
Ancillary Services



Market operators

Country /Region	Market operator for Ancillary Services	Market authority	Comments
Australia	Australian Energy Market Operator (AEMO)	The Australian Energy regulator (AER)	NEM covers 85% of the markets. Others are SWIS (7%) and two off-grid markets(8%)
UK	National Grid Electricity Transmission (NGET)	The Office of Gas and Electricity Markets (OFGEM)	
Ireland	EirGrid and SONI	The Commission for Regulation of Utilities (CRU)	
US Texas	The Electricity Reliability Council of Texas (ERCOT)	Federal Energy Regulatory Commission (FERC) and Public Utility Commission of Texas.	Covers about 90 % of the load

Australia



UK

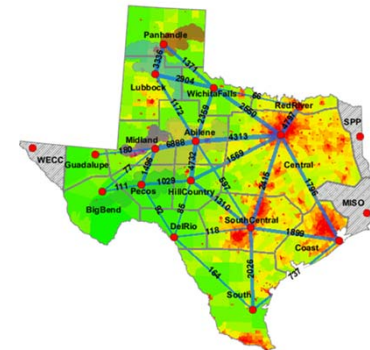


Transmission System Map



Ireland

US Texas



Classification of the ancillary service products

- The ancillary service products of 4 regions/counties (Australia, UK, Ireland and US Texas) are categorized in the following tables according to their activation time for frequency and voltage control
- The categorization responds rather well to the Nordic system

<u>System Service</u>	<u>Aim</u>	<u>Timeframe for activation</u>
Fast Frequency Response (FFR)	Increase the time to reach nadir/zenith	1-2 secs
Frequency Containment Reserve (FCR)	Contain the frequency	5 secs to 30 sec
Frequency Restoration Reserve (FRR)	Return frequency to nominal	30 secs to 15 mins
Replacement Reserve*	Replace reserves utilised to provide faster products	15 mins to hours
Voltage Control - Steady-State and Dynamic reactive power	Voltage control during normal system operation and disturbances	Long or short timeframe for activation. Dynamic < 40 ms

* Not in Nordic system

Fast Frequency Response (FFR), time frame about 1-2 sec



Region/Country	Number of products	Time frame to activation, (sec)	Duration of Service, (sec)	Providers
Australia	1 (under preparation)	0,04...2	Not decided	Batteries, flywheels and super-capacitors, wind turbines and wind pitch control, PV set point operation
Ireland	1	2	8	Conventional generators, CH, Biomass, wind farms, batteries, flywheels, PHES, CAES, HVDC ICs, AGUs, DSUs ¹³)
Texas U.S.	2	0,25...0,5	900...10800	Generators, batteries, loads
UK	1	1	900	Generators, storages, single or aggregated units
Nordic system	1	0,7...1,3	5...30	National hourly market based on inertia forecast

Irish ancillary service products most closely resemble the corresponding services in the Nordic system

Frequency Containment Reserve (FCR), time frame about 5...30 sec

Region/Country	Number of products	Time frame to activation, (sec)	Duration of Service, (sec)	Providers
Australia (raise, lower)	4	5 (normal) 6 (fast)	- 60	Batteries, flywheels and super-capacitors, wind turbines and wind pitch control, PV set point operation
Ireland	2	<5...15	15...90	Conventional generators, CH, Biomass, Hydro, wind farms, batteries, flywheels, PHES, CAES, Sync comps, HVDC ICs, AGUs, DSUs13
Texas U.S.	1	15...30	300	Generators or controllable loads
UK	6	10...30	20...indefinitely	Generators, loads
Nordic system (FCR-N, FCR-D)	3	180 s FCR-N 5...30 (FCR-D)	1800 1800	Power plants, yearly market, hourly market, other Nordic countries, loads

“The Mandatory Frequency response - Secondary response” and “the Firm Frequency Response – Dynamic, Secondary response” in the UK are somehow in the same time frame as Nordic FCR-D.

Frequency Restoration Reserve (FRR), time frame about 30 -300 sec and Replacement Reserves (RR) > 300 sec



Region/Country	Number of products	Time frame to activation, (sec)	Duration of Service, (sec)	Providers
Australia (raise, lower)	4	60...300	300...	Generator /load
Ireland	3	<90...1200	1200...3600	Thermal conventional generators, storage, loads, HVDC interconnectors
Texas U.S.	2	300...1800	1800...6300	Generators, HVDC lines
UK	4	120...5400	900...not defined	Generators, loads, energy storages
Nordic system (Automatic, manual)	2	120, aFFR 900, mFFR		Hydro power plants, yearly market, hourly market, own reserve power plants and reserve power plants

“The Fast Reserve (FR)” UK is somehow close to the Nordic FRR. The Nordic system does not have RR

Voltage and reactive power regulation

- No markets for voltage control and reactive power
- AEMO (Australia) may contract with market participants individually to provide this service.
 - Four types of payment: enablement, availability, testing, usage.
- UK compensation method:
 - Fixed payment for the Obligatory Reactive Power Service (ORPS)
 - The Enhanced Reactive Power Service (ERPS) is a tendered commercial service, but has not been applied since 2009.
 - Constraint management: Contracts (tendered commercial services) and Forward energy trades and OPRS providers.
 - Black start
- Ireland: Steady State Reactive Power, SSRP, Dynamic Reactive Response, DRR, Fast Post Fault Active Power Recovery, FPFAPR are compensated by contracts.
- US Texas: No compensation method based on the public data sources available for us.



Results/takeaways

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- 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 already have an equivalent that might 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 the EU level.
- Services such as voltage control and black start capacity are currently better served by regulations/grid codes or with bilateral contracts during the installation and refitting of individual units.

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