Demand Connection Code Public workshop Call for Stakeholder Input

Demand Side Response Delivering System Frequency Control

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Reliable Sustainable Connected

DSR Delivering SFC

The increasing need for frequency response services associated with high RES conditions.

- Frequency control is required by TSOs to deal with perturbations in demand as well as modest changes in generation in real-time.
- It is also required to deal with major system frequency events, the most significant of which is either a big infeed loss or a system split into two or more islands.
- Frequency control measures deal with demand and generation balance in seconds and minutes.
- The need in a given synchronous area has been defined by the largest loss which the system is designed to cope with. This varies from Ireland 500MW to GB 1800MW to Continental Europe 3000MW.

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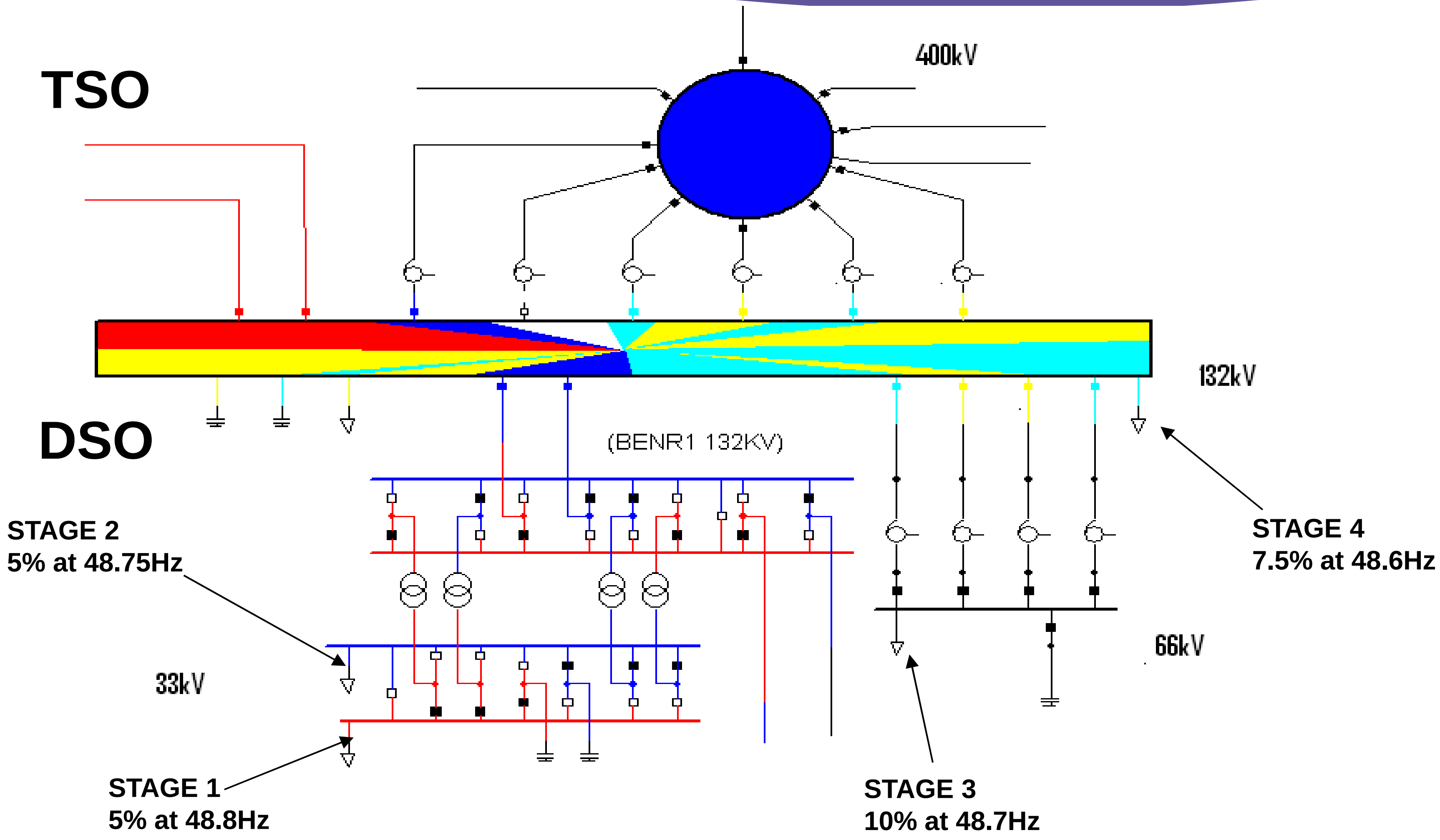
In the context of severe frequency events, introduction of large scale RES introduces two major new challenges.

1. RES delivered via power electronic converters severely reduces system inertia (ability to slow down frequency change).

2. The second challenge arises from the need for a means to cope with extreme events via defence plan measures, most notably Low Frequency Demand Disconnection (LFDD). **As per Diagram A on next slide**

DSR Delivering SFC – Diagram A (LFDD)



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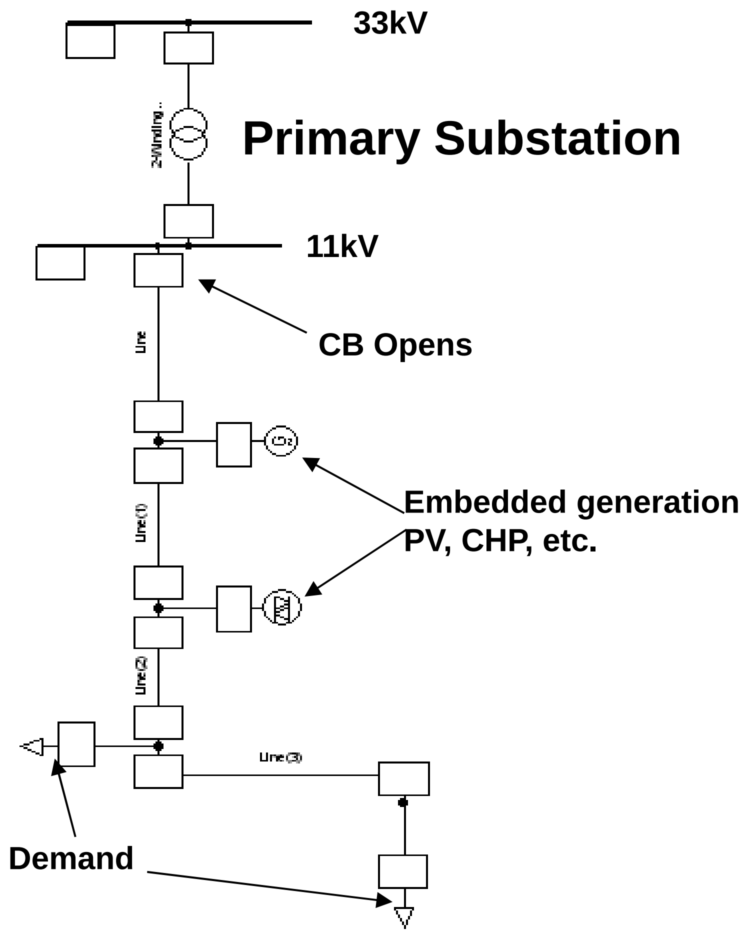

Deploying STAGE 1

The required 5% of demand reduction in MVA is not achieved.

Due to the mix of embedded generation and demand, connected to the selected circuit, this may yield 3% rather than 5% of demand reduction.

Therefore, increases the overall generation deficit.

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During windy and/or sunny times with high RES production synchronous plant is no longer “in merit” and is replaced by asynchronous RES generation (e.g. wind & solar PV).

Overall the consequence of the RES development is:

1. A large reduction in the availability of economic frequency response
2. Reduced system inertia and hence need for faster response
3. Less capability of dealing in a traditional way with extreme events

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What are the alternatives for providing frequency response within the scope of NC DCC using Demand Side Response (DSR)?

Two types of services could be provided by temperature controlled devices in the context of DSR SFC:

- Application in case of extreme frequency event, as a SMARTer LFDD service.
- Possibly for normal frequency management, i.e. related to high Wind penetration.

Temperature controlled demand (autonomous controlled) which has a target temperature with a small difference between the temperature it turns on and the temperature it turns off, is ideally suited to deliver such a service without inconvenience to the end user.

DSR Delivering SFC – Smarter LFDD Service

Smarter LFDD application for Extreme Frequency Events – Ireland case study, in 2005 - 639MW demand disconnection.

Type	MW in	% of peak load per	Number of units		% of peak load	Number of units	Units installed per annum
	2020	annum		2030	per annum		Assume Yrs turnover
Fridge/Freezer	80	1.6%	2000000	103	2.0%	2571662	171444
Industrial Refrigeration	618	12.4%	51768	794	15.3%	66565	4438
Heat pump	210	4.2%	400000	270	5.2%	514332	34289
Immersions	104	2.1%	210000	133	2.6%	270025	18002
Total	1011	0	2661768	1300	0	3422584	228172

DSR Delivering SFC – Smarter LFDD

The net annual savings of energy, capacity payment and rare historic events, are factors greater than the capital cost of implementing DSR SFC.

To demonstrate the impact of developing a market based delivery of DSR SFC and therefore excluding all other benefits and focusing on purely rare historical events.

MWh Value of Lost Load in Euros	MW available	**Total benefit value of DSR in Euros**	€2 Euro Capital cost		€3 Euro Capital cost		€5 Euro Capital cost	
10270	1300	13M	29	Years	19	Years	12	Years
10270	639	7M	14	Years	10	Years	6	Years
12500	639	8M	18	Years	12	Years	7	Years
25000	639	16M	35	Years	23	Years	14	Years

DSR Delivering SFC – Frequency Response

Normal Frequency Management Related to Extreme RES Penetration – GB case study

- The following case study shows the opportunities given by the use of temperature controlled devices in frequency management, for normal frequency response.
- Temperature controlled demand which has a target temperature with a small difference between the temperature it turns on and the temperature it turns off, is ideally suited to deliver such a service without inconvenience to the end user.

What are the ALTERNATIVES?

- Alternative 1: Voluntary service capability – mandatory usage
- Alternative 2: Voluntary service capability – voluntary use
- Alternative 3: Capability as standard, with mandatory delivery
- Alternative 4: Do nothing

DSR Delivering SFC – Frequency Response

	£/MWh	MW	10% in a Year (hrs)	Total £M
Cost to Deloading Wind (most expensive 10%, ignoring rest)	100	3300	876	**289**
	120	3300	876	347
	150	3300	876	434
	200	3300	876	578
	£/MW/h	MW	10% in a Year (hrs)	Total £M
Holding Cost on Wind for Response	0	3300	876	0
	5	3300	876	15
	10	3300	876	29
	15	3300	876	43
	20	3300	876	58
	25	3300	876	72
	30	3300	876	87
Taking minimum cost for deloading and ignoring holding cost for response , which is £290M + £0M				£290M

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DSR Delivering SFC – Frequency Response

Temeperature Control Potential for DSR	Total MW Potential for DSR	Total Net MW with load factor	Install/Replacement MW per year
Domestic Refridge/Freezer	2000	400	40
Commercial Air Conditioning	2800	840	84
Domestic Heat Pumps	1400	700	70
Industrial Refridge/Freezer	2600	260	26
	8800	**2200**	**220**

The potential Demand Side Response is governed by the duty cycle/load factor and the volume of new installed capacity each year, which is estimated as:

20% Domestic refrigeration yields 40MW / year

30% Commercial air conditioning yields 84MW / year

50% Heat Pumps yields 70MW / year

10% Industrial refrigeration yields 26MW / year

DSR Delivering SFC – Frequency Response

The cost in £M / year per 100MW of frequency response for the 4 alternatives is calculated. Also illustrating, at the end of a ten year period (replacement/installed) the accumulated MW available and cost will defer for each alternative, each compared with the holding cost for wind for 10% of that year when wind exceeds demand.

Alternatives		Dom F/F		Com Air Con		Dom H/P		Indus F/F		Total	Total	Summary
		MW	Cost £M	MW	Cost £M	MW	Cost £M	MW	Cost £M	MW	Cost £M	£M/100MW
1	Voluntary / Mandatory 20% take-up	80	3	168	3.6	140	2.4	52	1.8	440	10.8	2.5
2	Voluntary / Voluntary 10% take-up	40	32.5	84	7.8	70	5.2	26	3.9	220	49.4	22.5
3	Mandatory + Mandatory	400	10	840	2.4	700	1.6	260	1.2	2200	15.2	0.7
4	Do nothing constraint wind (nuclear for reserve)	0	0	0	0	0	0	0	0	2200	290	13.2

QUESTION to STAKEHOLDERS???

ENTSO-E believes these services below can be introduced for new appliances (and temperature controllers) without any detectable difference to the primary purpose of the service of the appliance. Can you share any specific knowledge or experience and associated data you may have on the following topic?

Regarding the DSR application related to temperature controlled demand to deliver a smarter, robust and a more user friendly <u>LFDD-capability</u> to avoid frequency collapse and hence contain the impact of rare events with large system frequency

Regarding the use of the temperature controlled demand beyond LFDD-capability for <u>frequency response</u>

Thanks for your attention!