

DINORWIG UPDATE: PUMPED STORAGE HYDRO KEEPS THE EVS CHARGING IN EUROPE

Presenters:

Roger Clarke-Johnson and Greg Yohe
Mercury Governor Group

Session SESS-60 Wednesday July 17, 2024 3:15PM



Coping with Variable Renewable Energy (VRE)

“Large-scale integration of VRE generation in power systems comes with key challenges: variability and uncertainty. Power system operators have historically been able to cope with these challenges.”

“In systems with very high shares of renewables this can lead to steep ramps when VRE rapidly changes their output ... The key driver for increased variability in the net-load is the mismatch between the system’s load profile and locally available VRE generation profile.”

Source Reference: IEA



System Inertia Is Key To Grid Stability

“System inertia, a property derived from synchronous generators, acts to mitigate the rate of change of frequency following a contingency event in the power system... VRE does not directly contribute to providing inertia to the power system since they do not have a direct, electro-mechanical coupling to the grid.”

“As VRE displaces thermal generation, system inertia will be reduced, causing the system to be less stable.”

Source Reference: IEA

UK ELECTRICAL & GAS TRANSMISSION SYSTEM

(ELECTRICAL SHOWN IN BLUE)

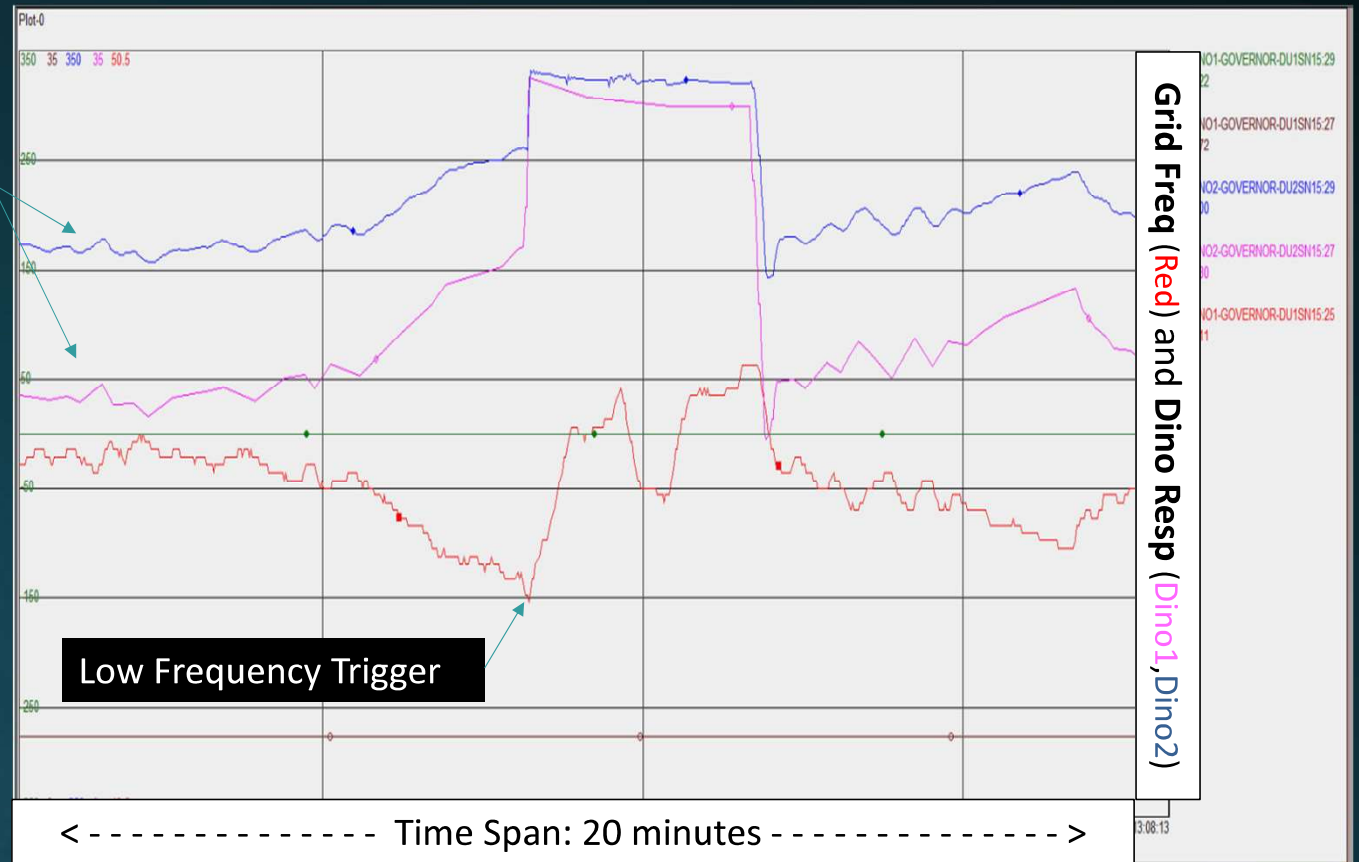


Courtesy: National Grid website

Control Mode: Low Frequency Response

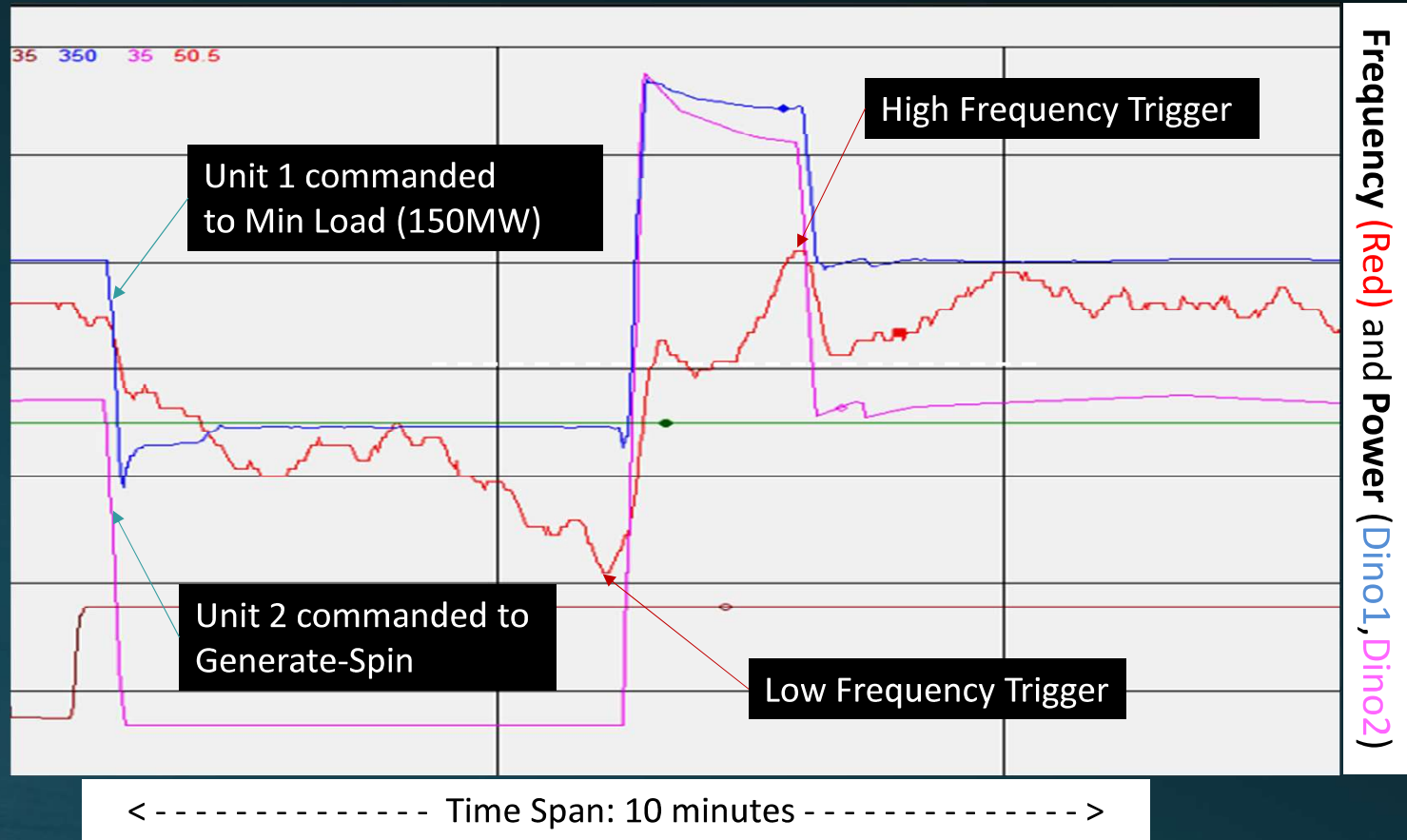
Normal Droop Response

DAYTIME
OPERATIONAL
SNAPSHOT
(1984 - 2010)



**DAYTIME
OPERATIONAL
SNAPSHOT
(1984 - 2010)**

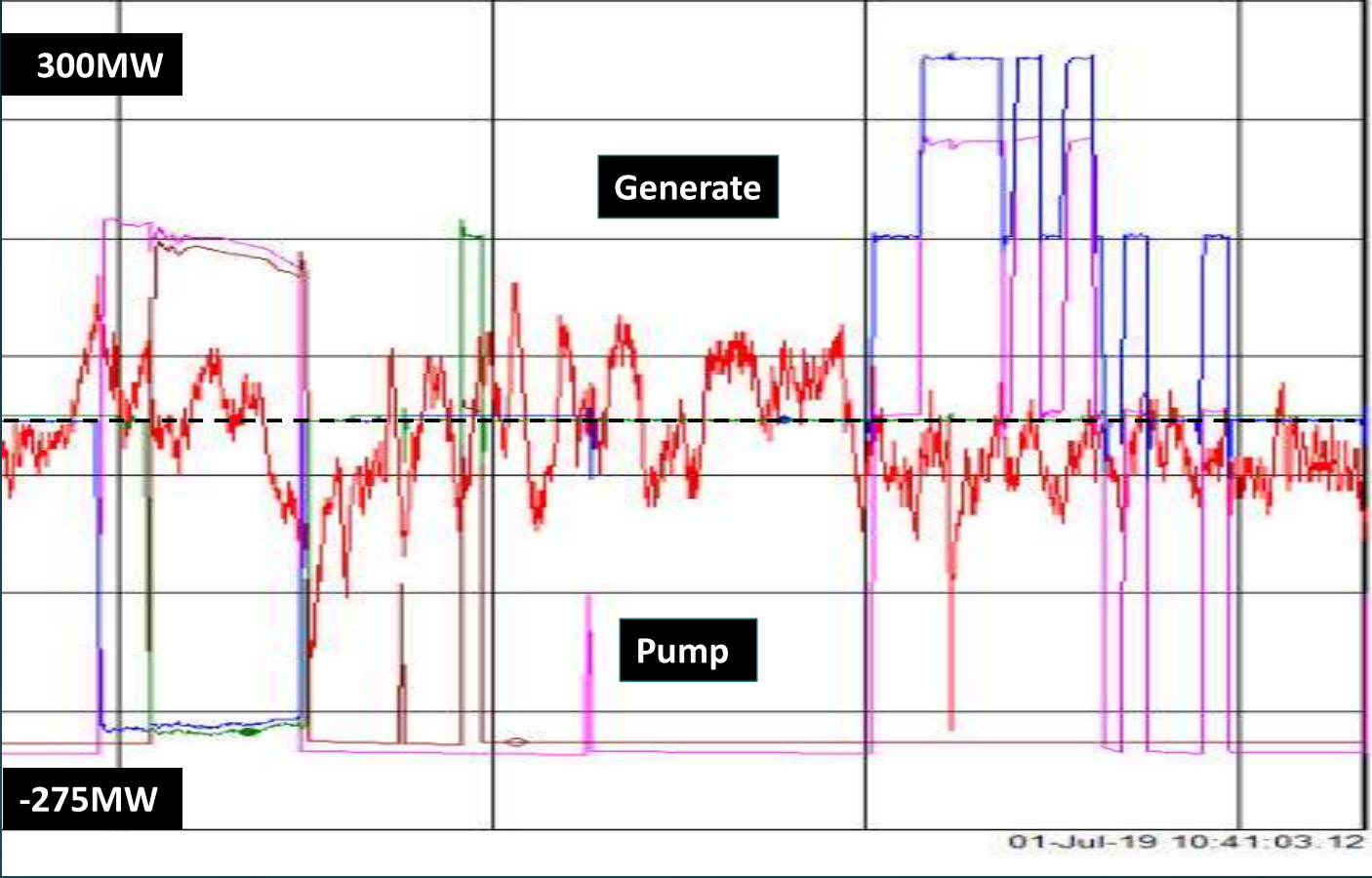
Control Mode Changes & Triggered Responses



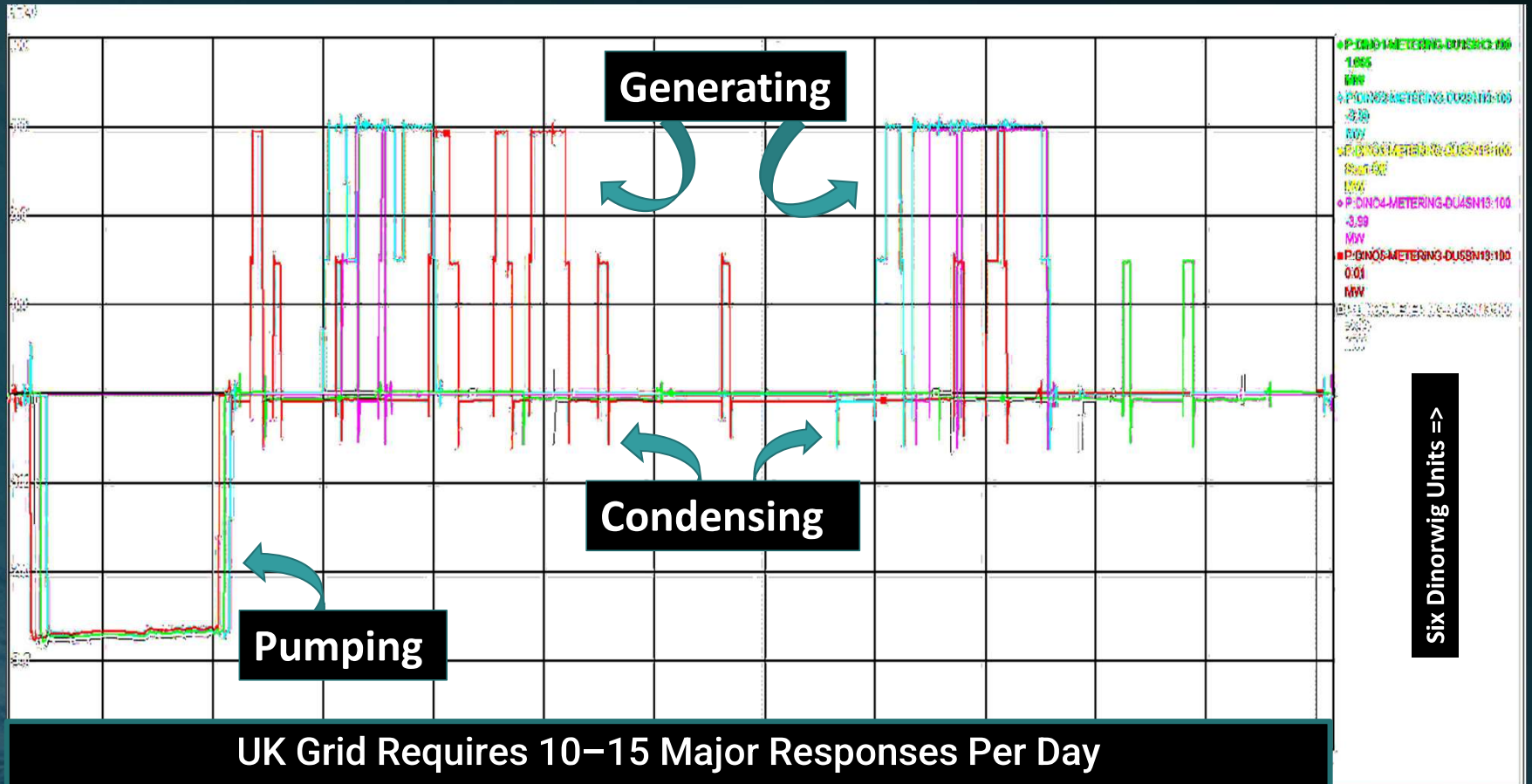
Frequency (Red) and Power (Dino1, Dino2)

Multiple Starts and Stops in Gen and Pump Modes

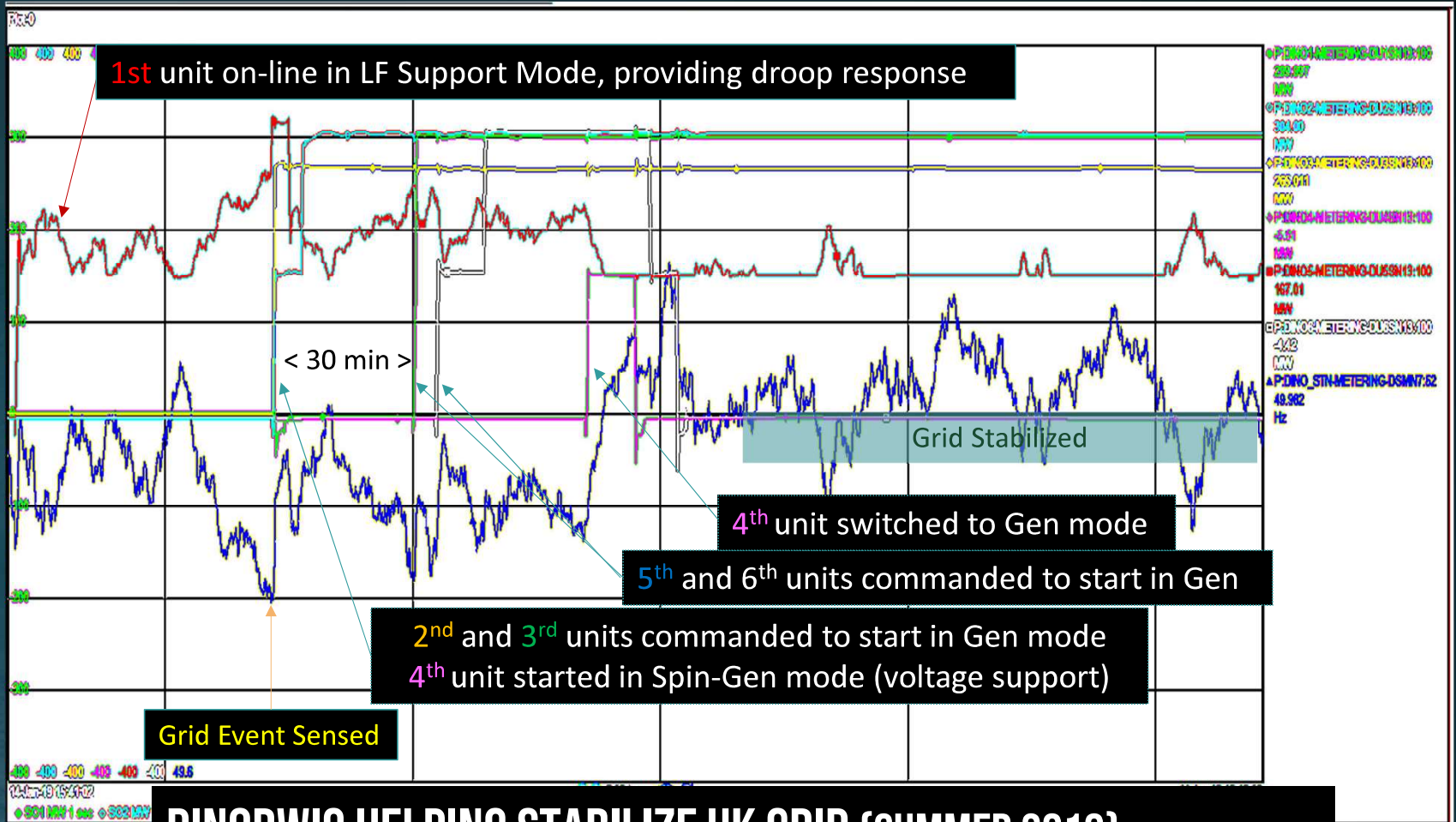
DAYTIME
OPERATIONAL
SNAPSHOT
WITH VRE
(2019)



24HR OPERATIONAL TREND WITH VRE (2019)



UK Grid Frequency is Blue



DINORWIG HELPING STABILIZE UK GRID (SUMMER 2019)




DINORWIG UPDATE 2024 - FIVE YEARS LATER

We went back to our contact at the powerplant and asked him for an update...

QUESTIONS WILL BE POSED IN THIS FONT

Answers will be in this font



**DID OUR UPGRADE TO THE GUIDE VANE LIMIT LOGIC WORK AS EXPECTED?
HAS IT EVER COME INTO PLAY SINCE IT WAS INSTALLED?**

Yes – We rolled it out on all six units and it has been active ever since.

I've seen it in action once, and it worked great, so that proves the theory!



IS THE INCREASING PENETRATION OF RENEWABLES IN THE UK HAVING MORE EFFECTS ON THE OPERATION OF DINORWIG?

For example: Are you pumping more during the day? Generating more at night? Do you use different control modes now, compared to how the plant used to be run?

Yes – We have a much different operating regime: daytime pumping, random generation, and no more Low Frequency Control (PLR) contracts. National Grid now requests Frequency Control ad hoc (no contract) ... and we charge them accordingly!

In terms of operating modes, we operate in Spinning Reserve a lot more now – in both Pump and Gen directions – to provide inertia to the grid.



SPEAKING OF SPINNING RESERVE, CAN THE UNITS GO FROM PUMP MODE STRAIGHT INTO PUMP CONDENSE MODE? IF THEY CAN, COULD YOU DESCRIBE THE SEQUENCE OF OPERATION?

Yes – Pump to Spin Pump is a common mode transition. Here's what happens:

The Operator initiates the mode transition.

The Governor ramps the Guide Vanes closed.

The Main Inlet Valve (MIV) closes.

The Blowdown and Balance valves open.

Spin Pump achieved.

THANK YOU FOR YOUR ATTENTION! ANY MORE QUESTIONS?

**Co-Author
Roger Clarke-Johnson**

BS Aero/Astro Engineering
University of Illinois

Sales and Marketing Director
Application Engineer
Technical Writer
Mercury Governor Group
Arlington, Washington USA

rcj@mercurygovernor.com

425-765-4413

**Co-Author
Greg Yohe**

Industrial Technology Certificate
Millersville University

Engineering Director
Field Service Specialist
Commissioning Engineer
Mercury Governor Group
Harrisburg, Pennsylvania USA

gregyohe@mercurygovernor.com

717-480-0197