

2008 International Wind-Diesel Workshop
The Hotel Alyeska, Girdwood, Alaska

April 23-25 2008

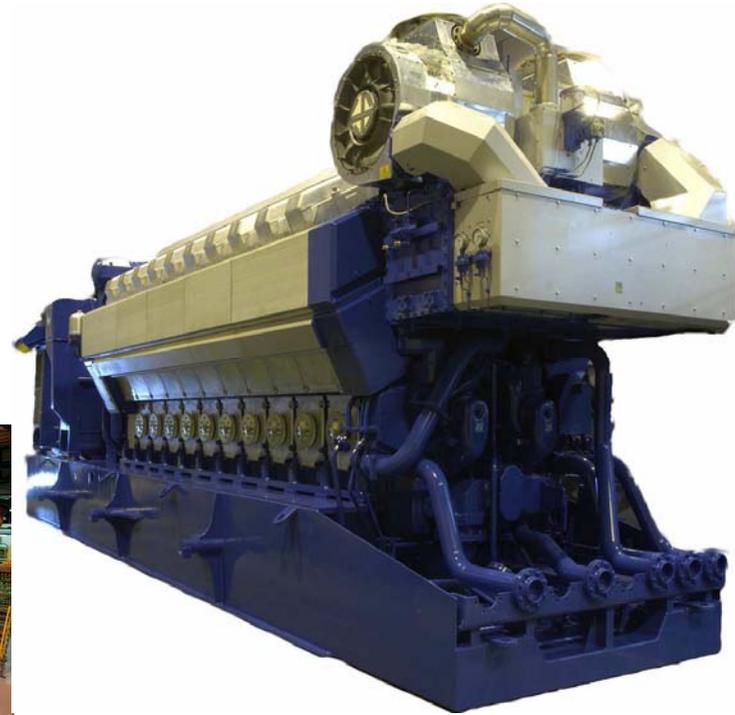
Wind-Diesel or Wind-Gas, Cases and possibilities by Wärtsilä

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Agenda for this session

- This is Wärtsilä
- Wärtsilä Power Plants
 - Diesel, Gas engines and biomass plants
- Wind-Diesel or Wind-Gas
- Ramp rates and cases
- Customer experience
- Conclusion



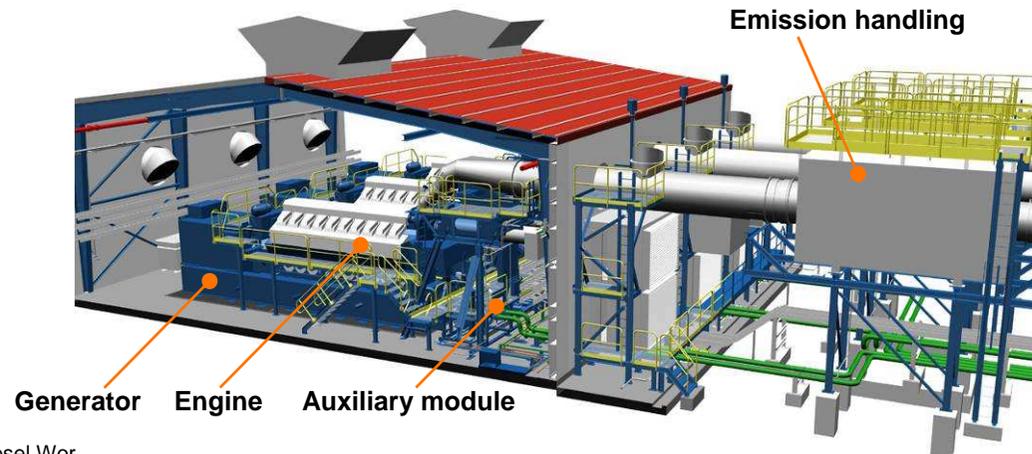
This is Wärtsilä

- We have 174 years of experience in power generation on land and at sea.
- Our businesses are: Power Plants, Ship Power and Services
- Our customers keep the world running, keep it powered and heated, keep commerce moving and energy flowing.
- We offer lifetime support of installations through design, solutions, service, spare parts and operational support.
- More than 15,000 people in 130 offices in 70 countries around the globe dedicated to achieving our customers' goals.
- Listed on the Helsinki stock Exchanges, headquarters in Helsinki, Finland. North American head offices in Houston



Wärtsilä Power Plants

- The choice for decentralized power generation in the range of 1-300 MW
- Wärtsilä has a installed base of about 37 GW of power plants in the world
- Turn-key or equipment delivery
- Based on reciprocating, medium speed engines
 - Oil Plants: LFO, HFO, Bio oils and Crude
 - Gas Plants: Gas and Dual-Fuel, Gas-Diesel
 - CHP Plants providing high total plant efficiency
- Modular design and operation flexibility enabled by the multi engine structure of the plants

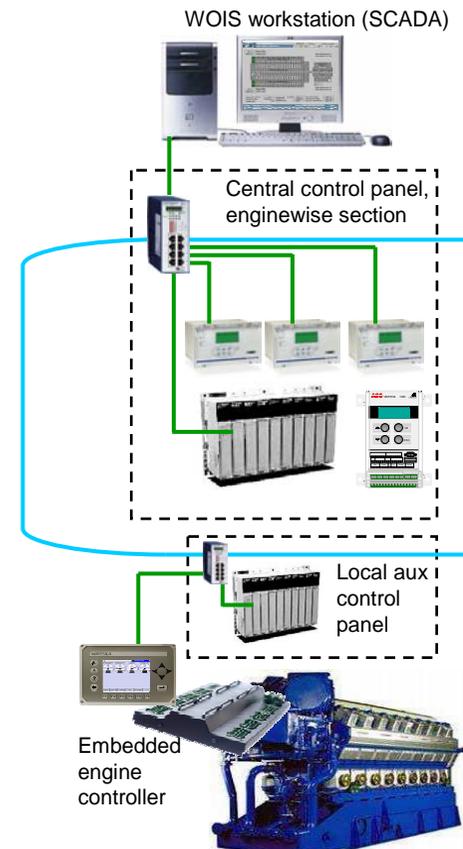


Wärtsilä and Wind-Diesel or Wind-Gas

- Our Wind-Diesel range starts when the generation need is > 5 MW
- Minimum 2 generating sets needed → faster response to fluctuations, additional flexibility and redundancy
- Suitable Diesel engines starts from W6L32 at 2,6 MW
- Suitable Gas engines starts from W9L34SG at 3,8 MW
- Advanced Power Management controls like:
weak grids, grid to island/factory load transfers, isochronous load sharing, load shedding, import/export control

... Is a daily business for us

We have the experience to extend the advanced controls and power management features to automatically provide a stable output from a hybrid wind-diesel plant



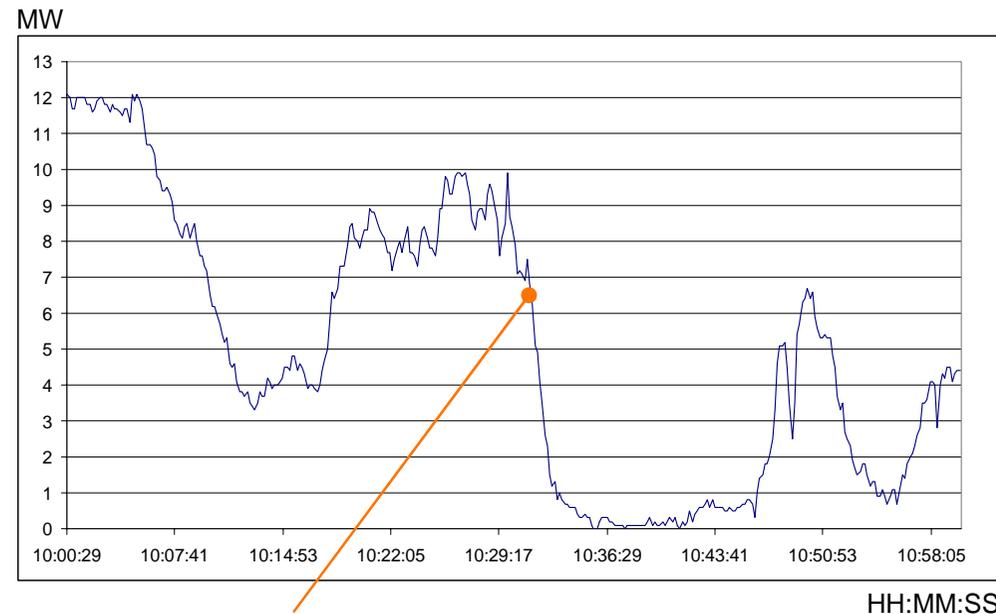
Wärtsilä Genset Ramp rates

- Excellent for load following and stabilizing:
- Diesel engine ramp rate is typically 30 kW/s * (Wärtsilä 32)
 - Meaning 1,8 MW per minute
- Gas engines ramps up from 0-100% below 10 minutes *



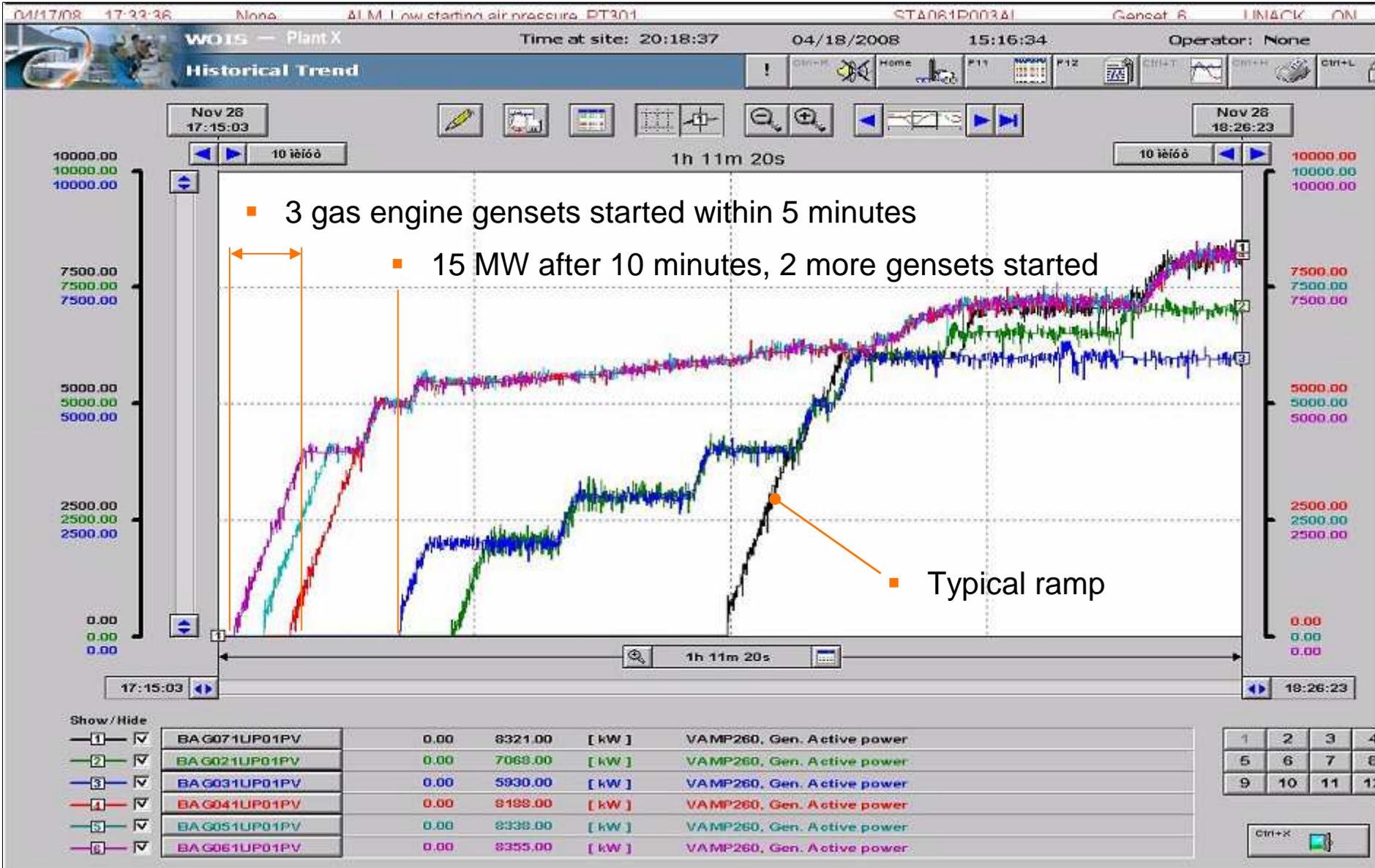
* In hot standby mode: engine pre-heated and pre-lubricated

- Case: 16 MW Wind maximum output, 8 wind turbines
- Wärtsilä gensets offered to stabilize the output to a certain hourly sold generating capacity
- Simulations based on wind data concluded that the optimal solution was 3xW12V32 LFO gensets, 5,3 MW each



- One of the “worst” situations in the analyzed recording data (turbine power generation) showed that the maximum power increase of the 3 diesel engines would be 3.8 MW/min = OK

Wärtsilä Gas Plant, typical real case start-up



Case: One US Customer's experience with a Wärtsilä Gas Plant

- Wind chasing facility when the wind drops off
- Peak shaving when not chasing wind
- Quick start: non-spin operating reserves
- Multiple starts per day during volatile periods
- Typically maximize response of the units
- Over 200 starts per year, multiple units at a time
 - Consumption swings >10 MW 2-3 times per hour
- More cycling as our wind portfolio expands



Conclusion and future



- Wind-Diesel or Wind-Gas + Fuel Cells
- Fuel flexibility and emission controls are key items
- Advanced automation with all the intelligent plant devices integrated to a Plant communication
- Our big base of remote on-line monitored plants will be heading for remote management services



Questions?



Thank you!



WÄRTSILÄ

Learn more about us at www.wartsila.com