



Vici Ventus
3 owners with complementary knowledge and expertise

	Lyse	DR. TECHN. OLAV OLSEN AS	AF GRUPPEN ASA
Turnover	NOK 4.4 Bn	NOK 230 Mill	NOK 5.9 Bn
Profit	NOK 2.4 Bn	NOK 17 Mill	NOK 328 Mill
# employees	~800 employees	93 employees	~2.100 employees
Business	Lyse is a utility company owned by 16 local communities within the county of Rogaland, Norway. Business includes production and sales of energy- and telecom products, as well as building and maintaining infrastructure.	Dr.techn.Olav Olsen a.s (OO) is an independent structural and marine engineering company, with a world leading role within conceptual development and design for the civil construction and oil and gas industry.	AF Gruppen ASA is one of Norway's largest construction companies, with activities onshore and offshore. Leading within onshore wind and de-commissioning of offshore structures. AF is short for "Addressing Future", describing the ability to think long term and innovative.
	"Business Development, power production and sale. Large energy projects"	"Engineering and design of offshore installations"	"Large construction projects onshore and offshore"

Vici Ventus Technology AS – General Information

- Vici Ventus was founded in September 2009
- Overall strategy is to deliver cost effective foundation structures to the offshore wind industry
- Beside detail design and delivery of foundations Vici Ventus can provide services in early development phases as well as concept verification and FEED studies
- Core Products
 - Concrete Gravity Structure – fixed foundations for water depth 30-100 m
 - Steel Space Frame Tower – fixed foundations for water depth 20-70 m
- Vici Ventus will have access to fabrication facilities in Vats, Norway for delivery to the North Sea market.
- Vici Ventus will search for partners internationally for delivery to foreign markets, in order to fabricate foundations locally

Concrete Foundations

Gravity base or skirt piles



Offshore Wind – Challenges and Opportunities



• Challenges

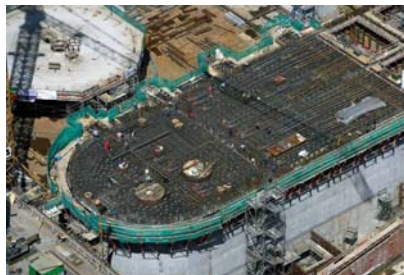
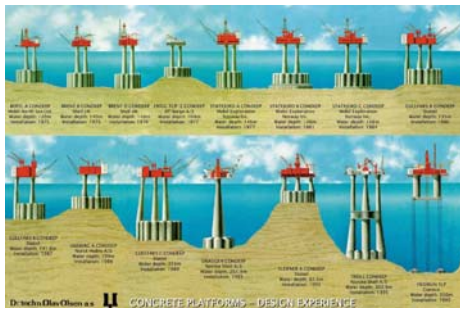
- More expensive than onshore
 - Installation
 - Access
 - Cables and substations
 - Foundations
- Weather and sea state
- Availability of cranes, installation vessels and sub-sea equipment
- Marine environment issues

• Solutions

- Simple and robust equipment
- Weather insensitive installation
- Avoid high cost offshore vessels and equipment
- Design for long life
- Design for larger wind turbines if cost efficient (not possible onshore due to transport restrictions etc)



Offshore Concrete Foundations – Relevant Design Experience



Vici Ventus Concrete Foundations – Main Features



- **Simple and robust mono tower structure**
 - Based on 30 years successful industry
 - For water depths up to 100 m +
 - Long design life, 100 years +
 - Can support larger turbines in the future
 - Optimal stiffness and dynamic characteristics
 - Not fatigue sensitive
 - Maintenance free
 - Firm or soft soil
- **Marine environment friendly**
 - No piling
 - No anchors



Vici Ventus GBS Concrete Foundations – Marine Operations

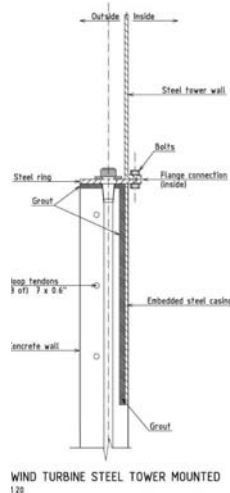


- **Self floating and stable structure**
 - Buoyant shaft for floating stability
- **Inshore assembly and hook-up**
 - Inshore lift-installation of tower and turbine, well controlled and safe operations
 - Relatively “low cost” floating cranes
- **Complete turbine towed to site**
 - Robust, not sensitive to weather
- **Installation by ballasting only**
 - No use of offshore crane vessels
 - Short duration, reversible, robust, Hs=3 m
 - Normally no seabed preparation
- **Simple removal by reverse installation**
 - Allow for reuse



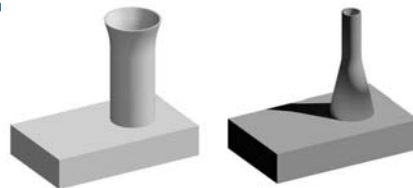
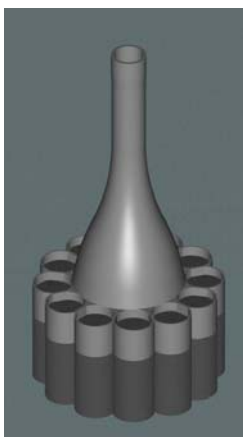
*The Hywind experience
Inshore assembly =
Low cost & risk*

Concrete Foundations for 40 m water depth – Case Example



- Based on North Sea conditions, air-gap 20 m, H_{\max} 21,2 m
- Concrete structure designed with sufficient floating stability to carry complete turbine (5MW Repower) from inshore building site to installation site
- Base Slab diameter 40 m
- Shaft diameter 24 – 6 m
- Towing draft 35m
- Net concrete volume 2500 m³
- Solid ballast 13000 tonnes (inshore and offshore)

Technology Concrete Gravity Foundations



Concrete GBS "Raft" for shallow waters

- Self floating
- Inclined installation



Concrete GBS – Sakhalin 2

- Inclined installation method

Concrete GBS w/ skirts

- For soft soil, 30 m WD
- For soft soil, 10 m WD
- Self floating/installed
- Self floating/installed



(www.afgruppen.com)



AF Miljøbase Vats

A perfect site for construction of foundations for offshore wind turbines

- The largest offshore concrete structures have been finished in the fjord outside Vats
 - Troll A, Draugen, Gullfaks C were finished here due to limited waterdepth in Gandsfjorden
- Deep water available
 - 182 m long quay with 23 m waterdepth
 - Accessed by worlds largest offshore lifting vessels (Thialf, Balder, Saipem S7000 etc.)
 - Minimum 220m waterdepth during transit
- Top modern yard facility with all required certificates
- Good infrastructure
- 100% owned by AF Group



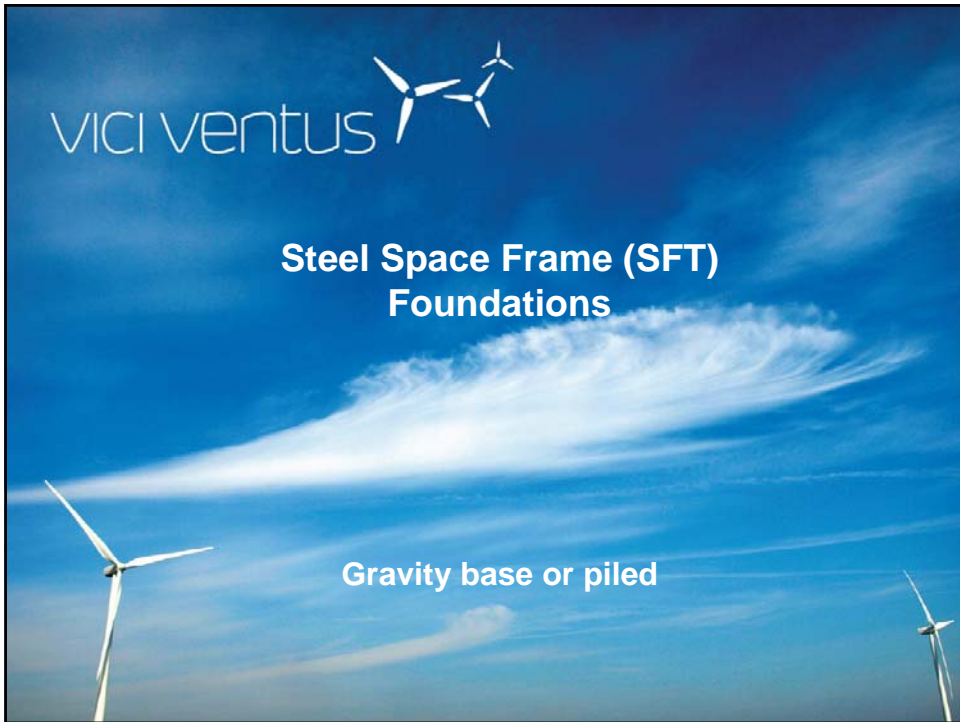
Construction of Draugen in Vats



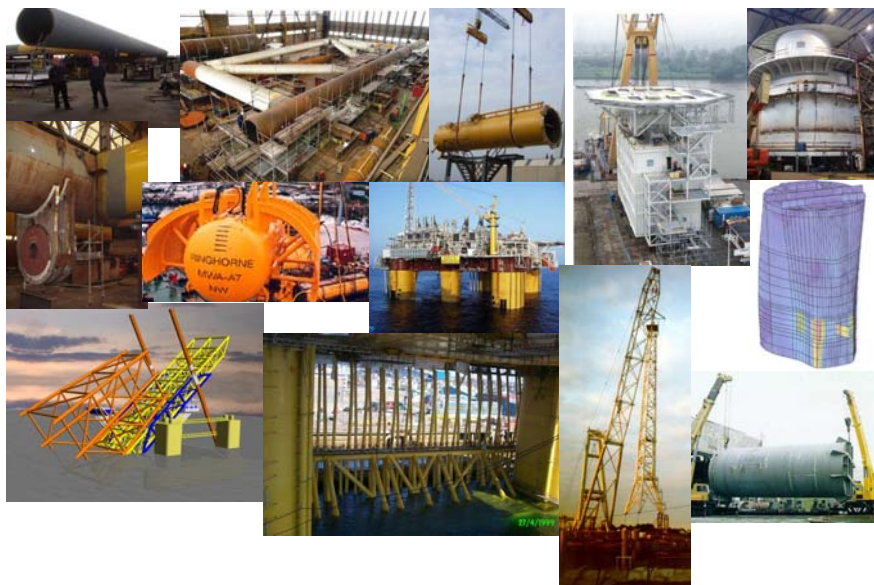


Steel Space Frame (SFT) Foundations

Gravity base or piled



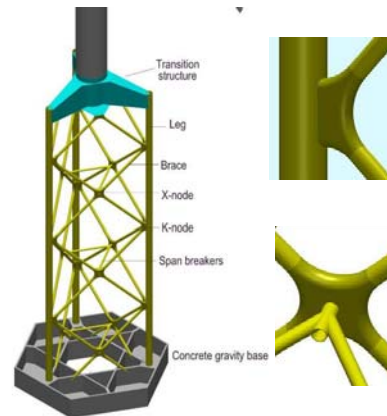
Offshore Structures – Experience steel



Space Frame Tower (SFT)

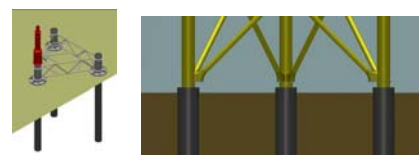
Main elements:

- Foundation - different solutions
 - Gravity base
 - Suction buckets
 - Piles
- Space Frame Tower, 3 main element types
 - Vertical legs with constant outer diameter and variable thickness
 - A uniform node design for both X and K nodes. The nodes have superior fatigue capacity and are cost effective in fabrication.
 - Uniform X-bracing system with one brace diameter
- Transition structure, standardized for turbine, independent of site conditions

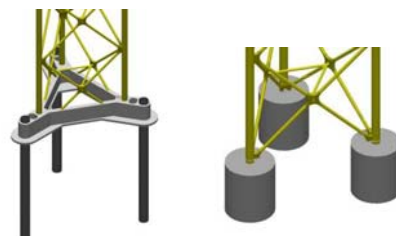


Foundation types for SFT

- Gravity base structure that can be ballasted with sand/gravel - Pre installed or installed with the structure
- Piles pre installed directly under the legs or through pile sleeves outside the legs
- Piled foundation frame – pre installed
- Suction buckets pre installed directly under the legs or as foundation for a frame



Pre installed piles

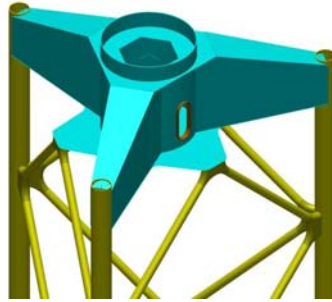


Piled foundation frame

Suction buckets

Transition Structure

- Standardized design for each turbine size and make
- Present design for 5MW turbine of 410 tons and tower height 69m above transition
- Central cylinder 5,5m in diameter and 6m height
- Designed with the same fatigue life as the tower
- Weight of structure 120 tonnes
- Access by outside platform and door in central cylinder.
- Excellent space for equipment

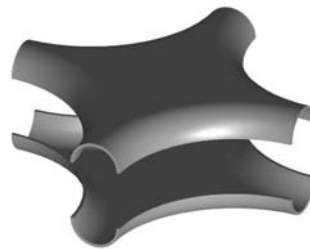


To standardize the design, the highest design requirements must be applied to secure capacity for any application. This means that it will be oversized for some cases. This will have small influence on the total material cost. However, from a cost point of view, very much will be gained by providing a ready detail design with all specifications. Also quality will gain by this approach.

Node fabrication



Hot forming with hydraulic press



Welding two halves together to an X-node



Splitting X-node into two K-nodes

End of Presentation

