

4.2MW 대형 풍력터빈 개발 현황 및 전망

2019. 06. 14

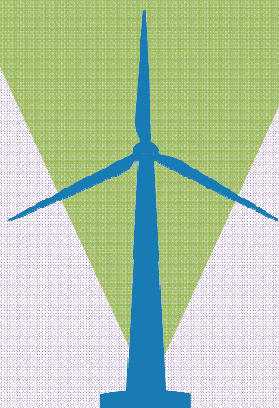
유니슨주식회사

U4 플랫폼 개발 전략

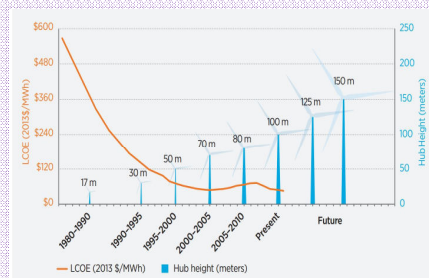
- 육상풍력터빈의 대형화 필요성

WHY?

토지 가용성 증대
비용 저감



[풍력터빈 대형화 및 LCOE]



- 대용량화
- 저풍속화
- Plug & Play 모듈화
- 고신뢰성 드라이브트레인



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Technical Data

POWER REGULATION

Type	Variable speed, Pitch regulated
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OPERATIONAL DATA

Rated power	4,200 kW
Cut-in	3 m/s
Cut-out	22 m/s
Wind class	IEC 1A
Operational Temp.	-15°C ~ 40°C
Survival Temp.	-20°C ~ 50°C

SOUND POWER

Maximum (with Trailing Edge Serration)	105 dB(A)
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ROTOR

Rotor diameter	136 m
Swept area	14,520 m ²
Weight	114 ton

ELECTRICAL

Frequency	50 Hz / 60 Hz
Generator	PMSG
Converter	Full scale

GEARBOX

Type	Two planetary + One helical
Weight	38 ton

TOWER

Hub height	95 m
Weight	293 ton

NACELLE

Height x Width x Length	4.0 m x 4.5 m x 14.7 m
Weight	167 ton

HUB

Height x Width	4.0 m x 4.5 m
Weight	50 ton

BLADE

Length	66.5 m
Max. Chord	4.5 m
Weight	19.5 ton

MODULE

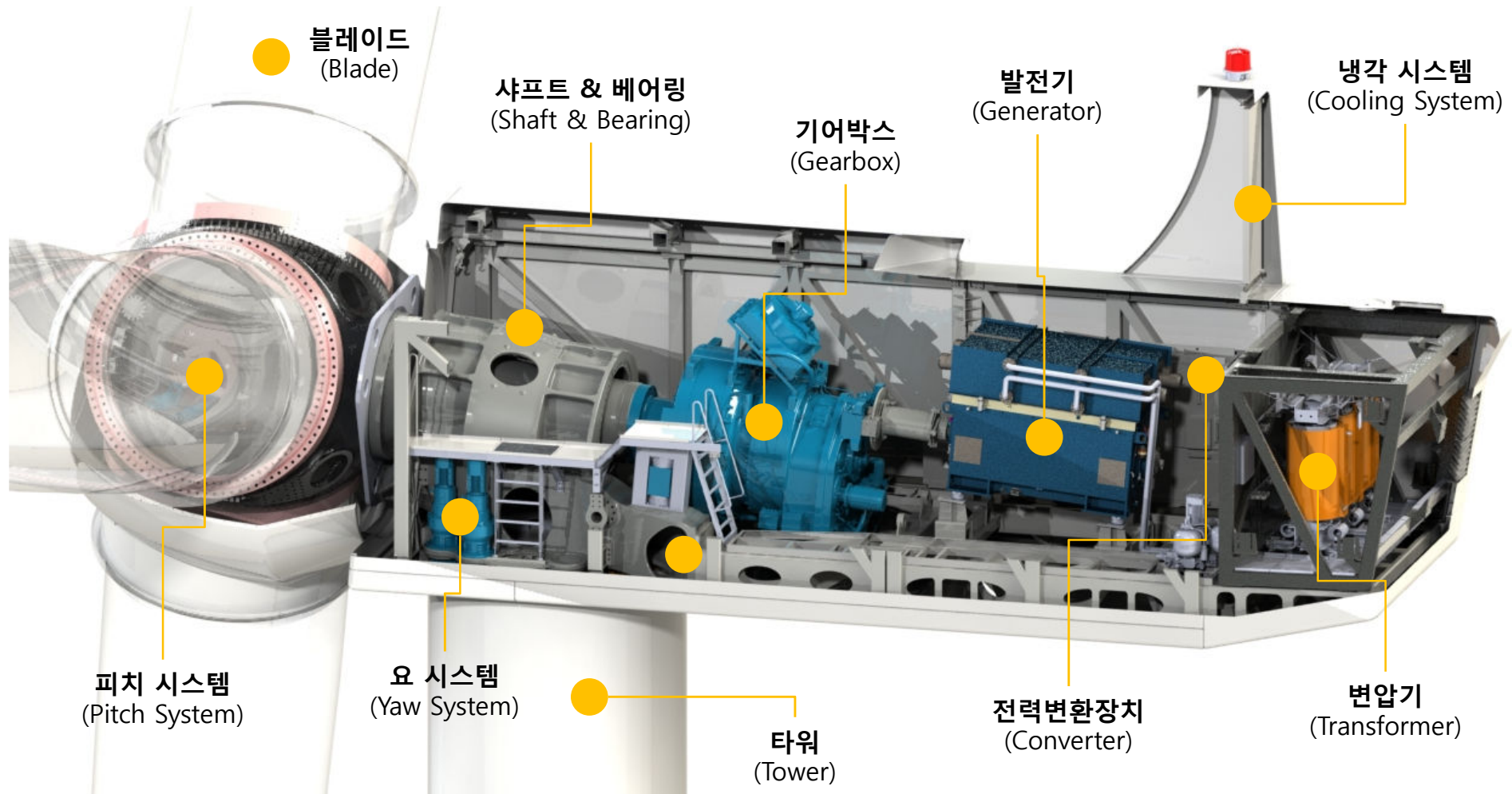
Max. weight per module	78 ton
Top Head Mass	276 ton

※ Disclaimer: Specifications can be changed without prior notice

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나셀 배치



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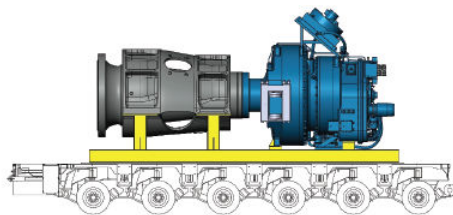
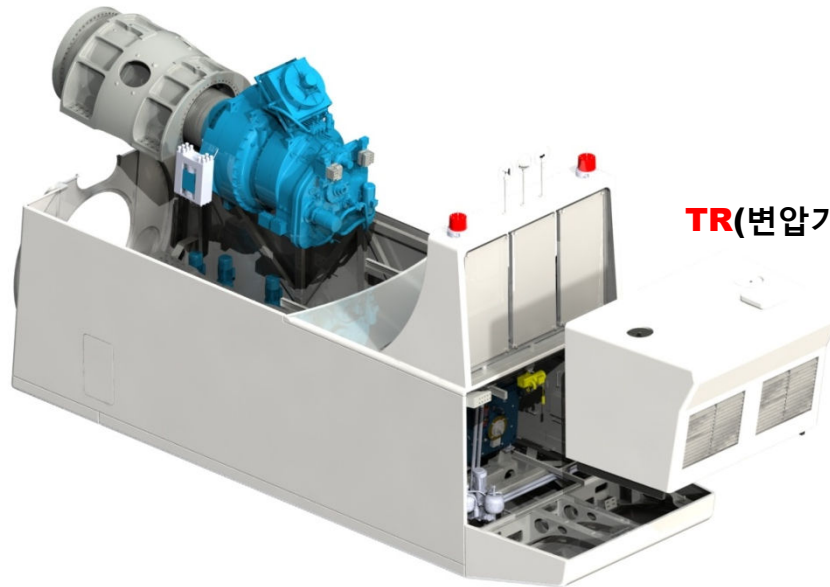


모듈식 나셀 구조

DT(드라이브 트레인) 모듈

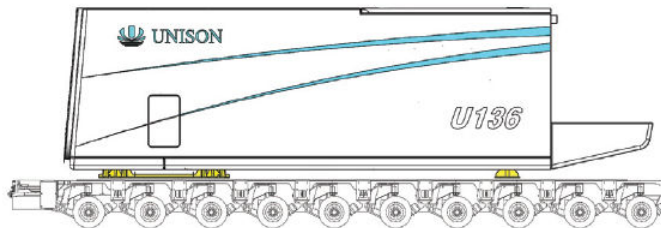
NA(나셀) 모듈

TR(변압기) 모듈



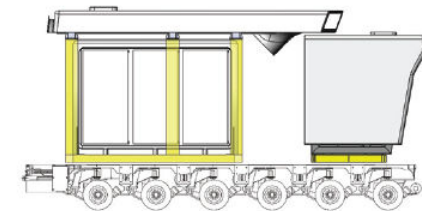
DT 모듈

78 ton (L7.2m x W3.5m x H3.8m)



NA 모듈

73 ton (L14.7m x W4.5m x H4.2m)



TR 모듈

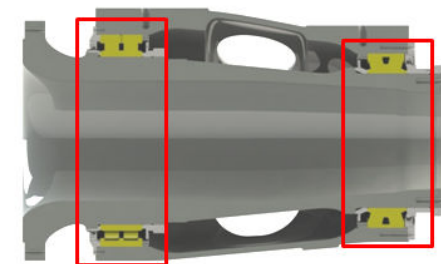
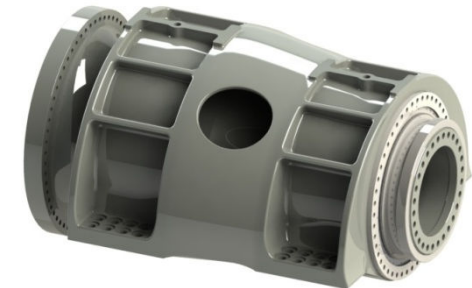
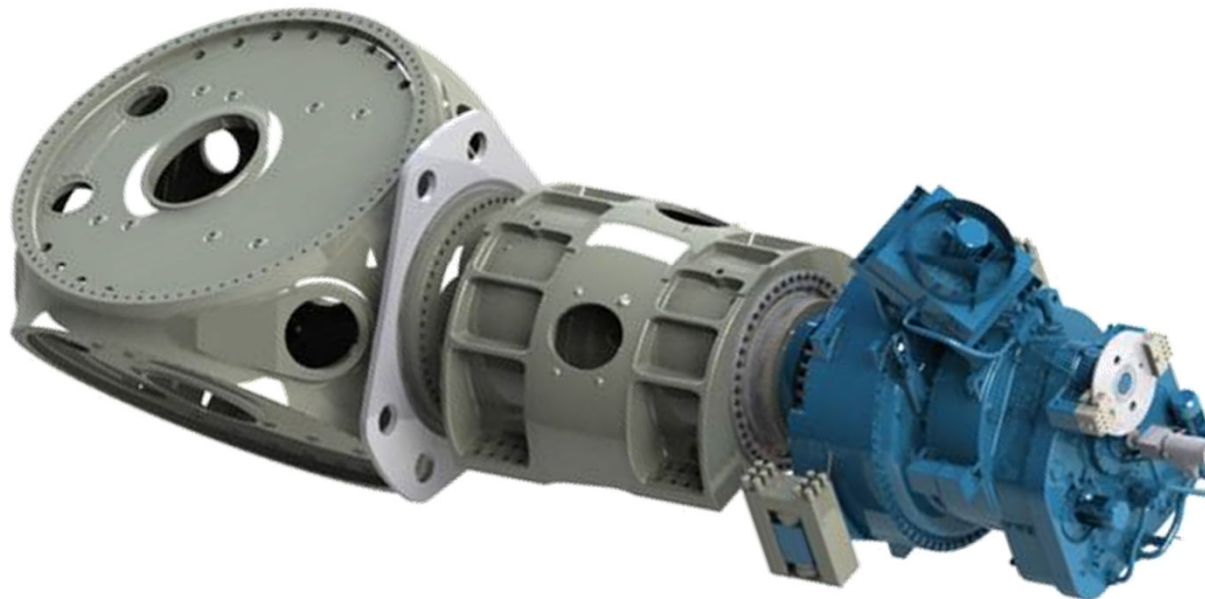
16.5 ton (L10.0m x W4.5m x H4.0m)

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동력전달장치

- 4 point 드라이브트레인 지지 구조
- 'Zero-play' 베어링 구조 (DCRB + DTRB)
- 기어박스에 전달되는 굽힘하중 최소화

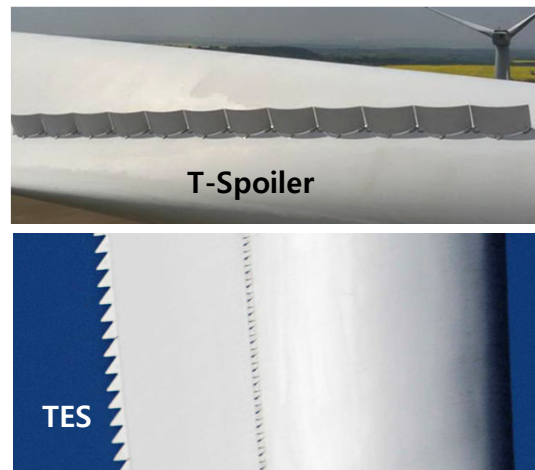
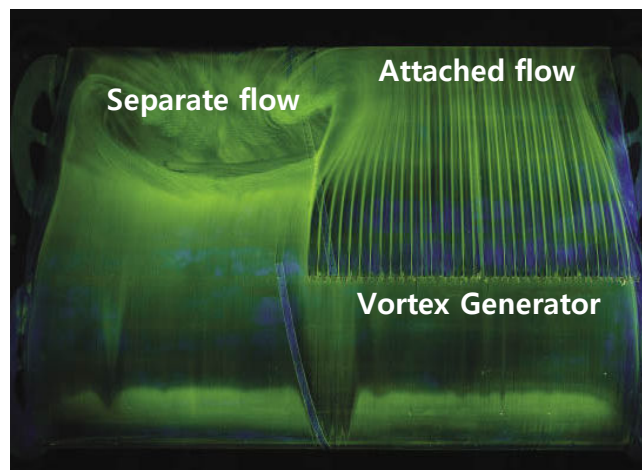
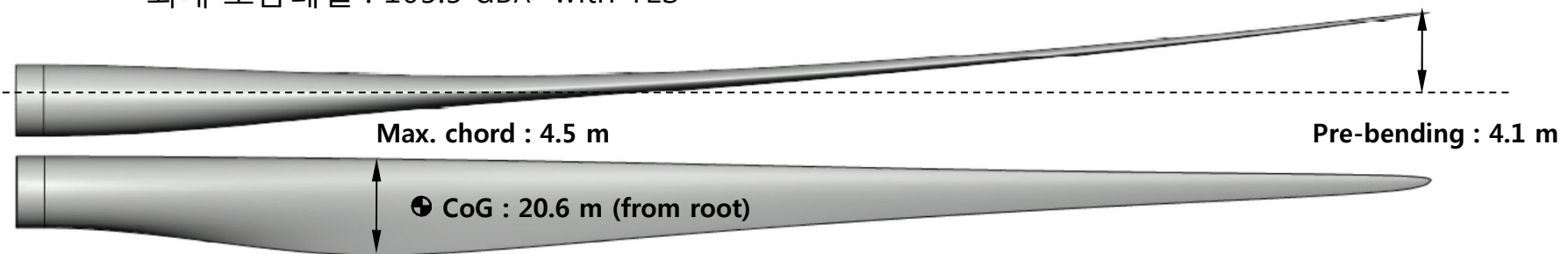
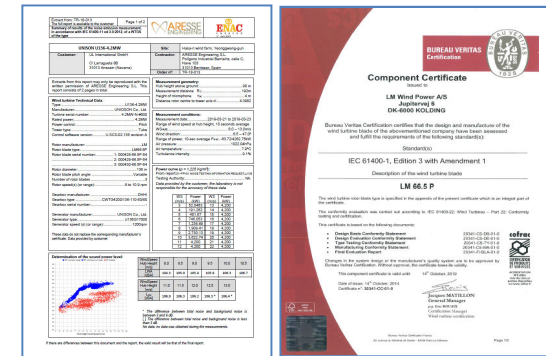


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블레이드

- 길이 : 66.5 m
- 중량 : 20 ton
- 재질 : GFRP
- 최대 소음레벨 : 105.5 dBA with TES

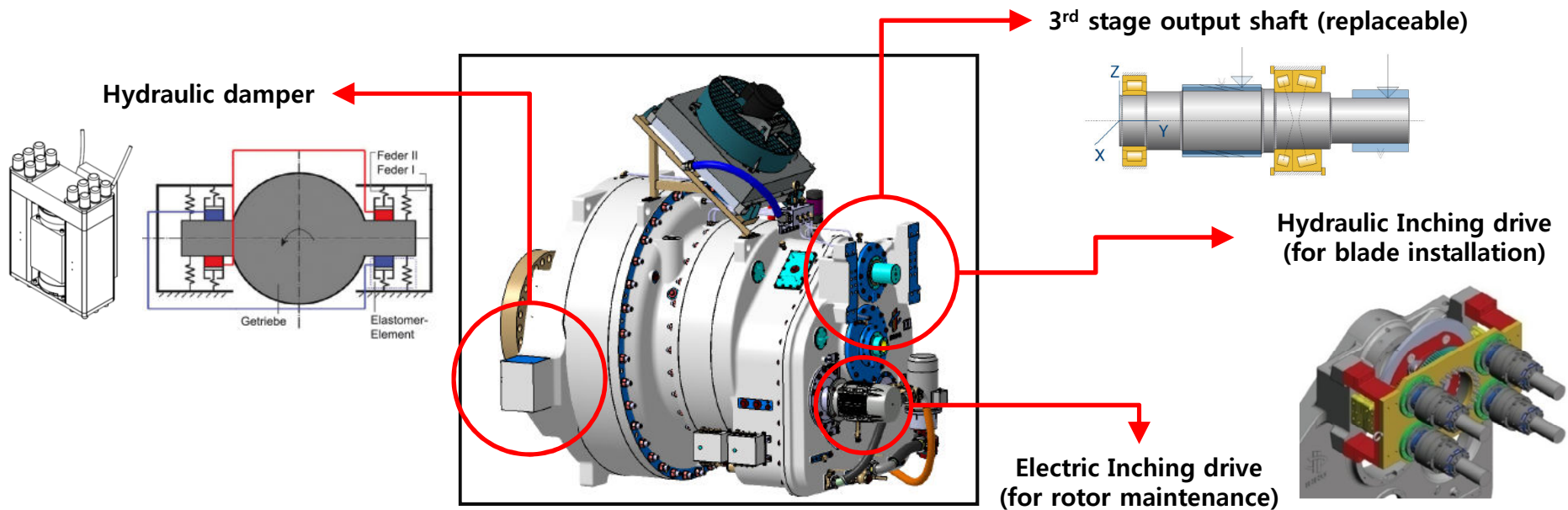


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기어박스

- 습식 윤활
- 유압댐퍼를 사용하여 기어박스의 구속력 감소
- 로터 유지보수를 위한 전기 인칭드라이브 및 싱글블레이드 설치를 위한 유압 인칭드라이브
- 고속단 축/베어링/기어 교체 가능
- Robustness 시험을 통한 검증 : 110% rated torque x 100hr
- 부품인증 획득 (DNVGL)

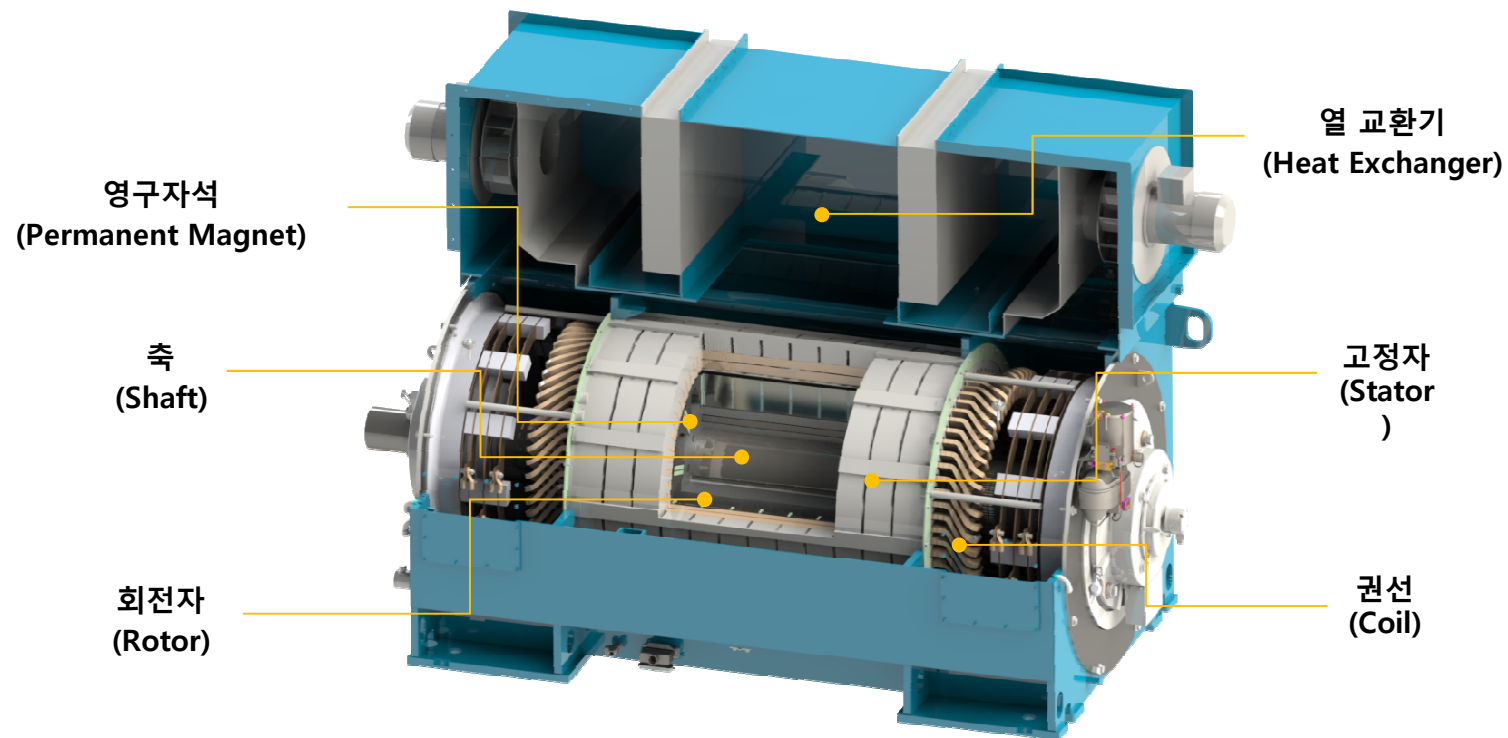


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발전기(1/2)

- 영구자석 동기 발전기
- 매립형 영구자석
- Maintenance free
- 밀폐형 구조

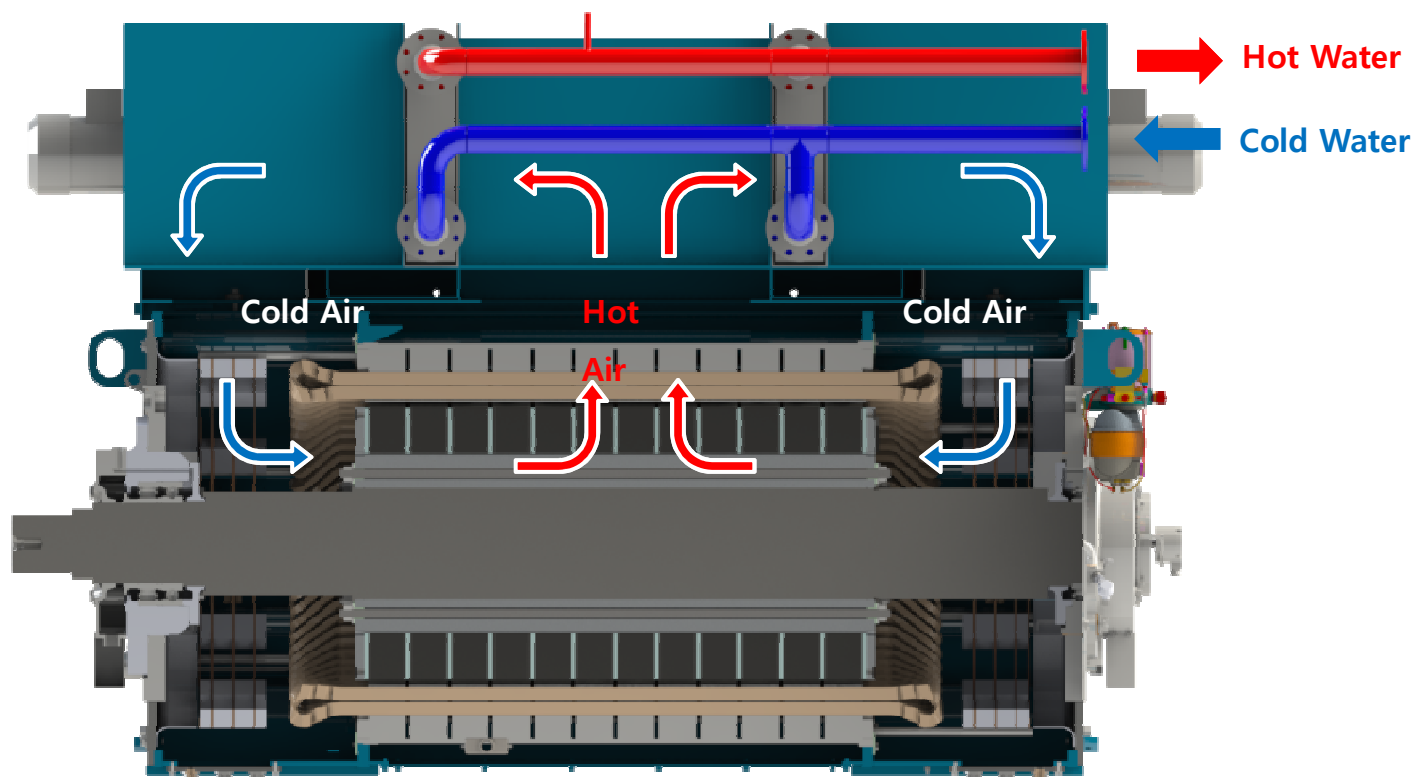


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발전기(2/2)

- Air to Water 냉각 방식 적용
- 누수 감지 기능

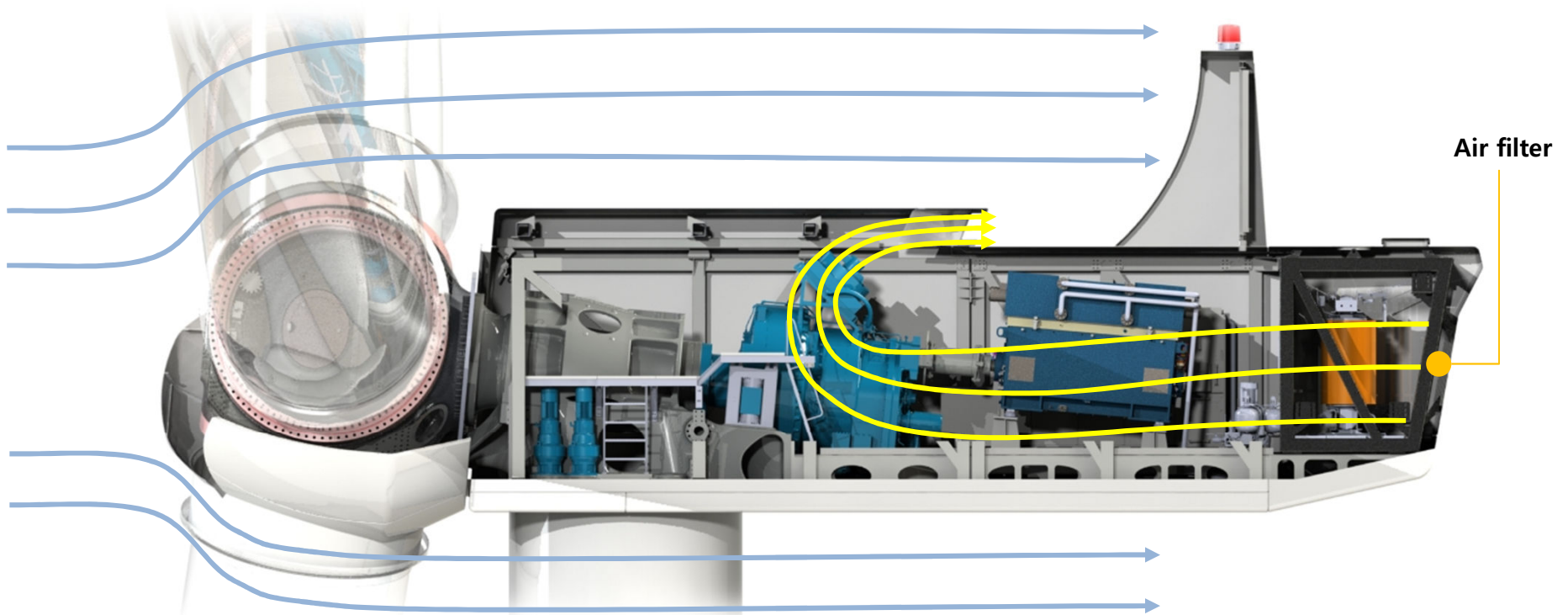


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냉각시스템

- 자연풍을 이용한 Passive 냉각시스템
- 나셀 ventilation 기능
- 염분제거 및 수분제거 필터



전기시스템

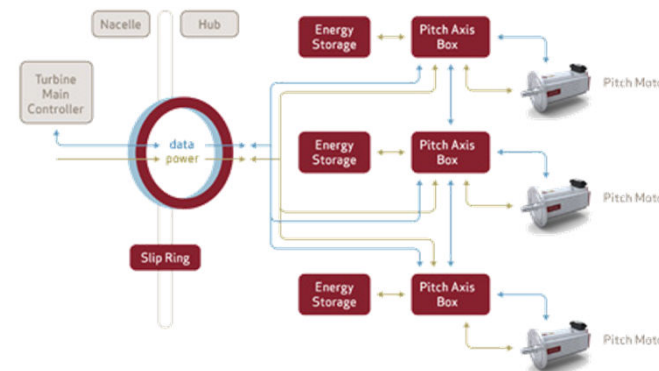


전력변환 장치

- Full AC/DC/AC 변환
- 다양한 국제 계통 코드 요구사항 준수
- LVRT(Low Voltage Ride Through) 와 주파수 Droop control 가능

피치시스템

- AC 모터를 적용한 전기 피치 시스템
- 독립된 2중 블레이드 각도 검출 구조
- 울트라 캐패시터 백업



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제어기 & 스카다(SCADA)

제어기

- 최신 기술이 적용된 IEC 61400-25를 충족하는 제어 소프트웨어
- 검증된 고품질 하드웨어 적용을 통한 안전 알고리즘 강화

SCADA

- 웹(Web) 기반으로 모든 정보 온라인으로 접근가능
- 실시간 데이터 분석, 자동 보고서 생성, 발전량 검토, 이벤트 보기, 경보 및 기타 정보
- 고객 요구를 충족시킬 수 있는 사용자 친화성 및 유연성 확보

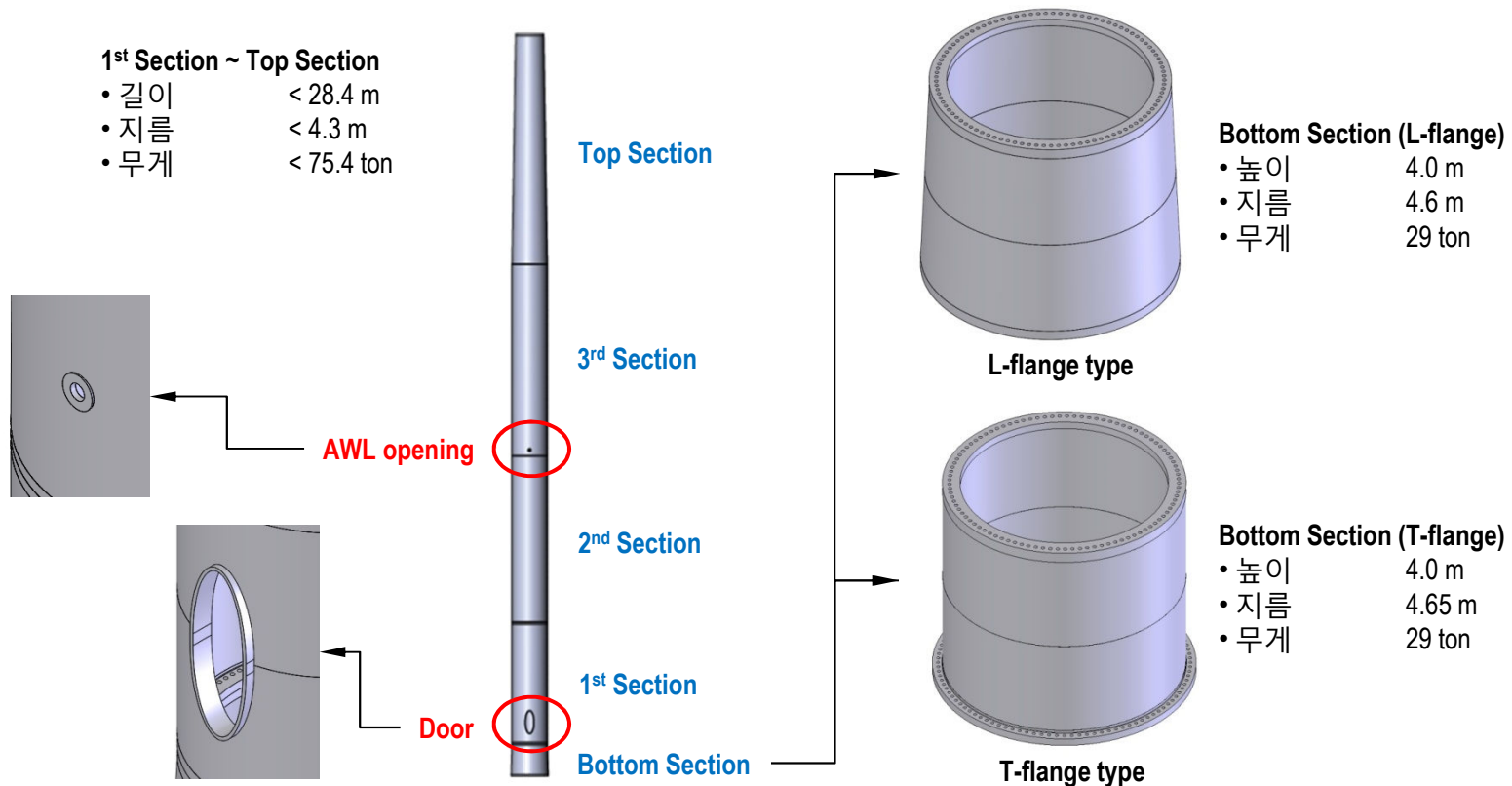


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타워

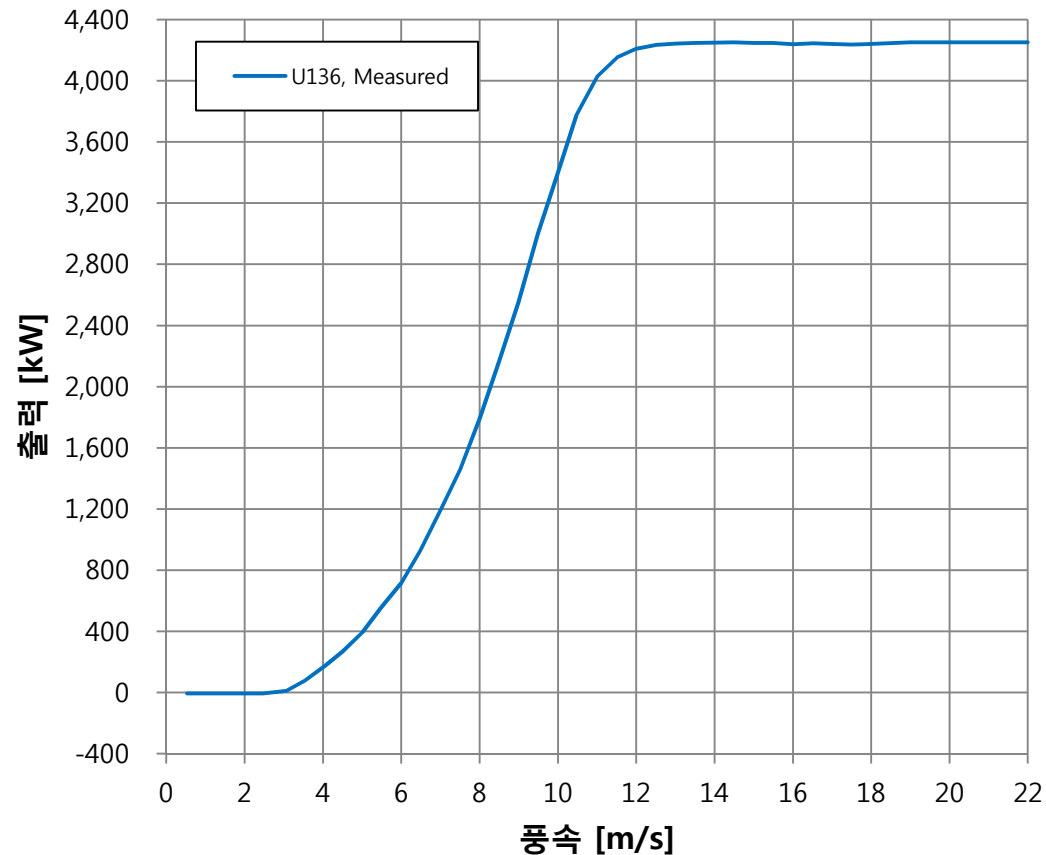
- 한국건축기준 2016이 고려된 지진설계 (MMI* VII 0.261g) *Modified Mercalli Intensity(수정 머칼리 진도)
- 해상에 준하는 부식 방지 코팅(C5-M)
- 두 종류의 bottom section: L-flange type(Embedment 기초) & T-flange type(앵커볼트 기초)



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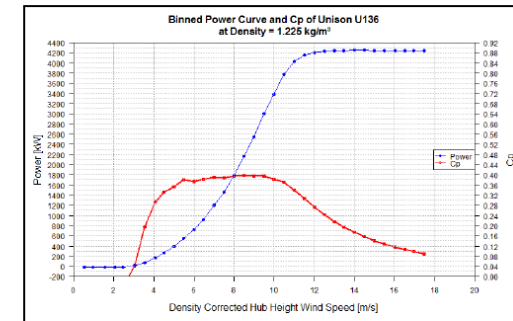
출력성능



Deviations from the standard

- The laser range finder device to measure the instrumentation height has not been individually calibrated. This has been considered in the reported measurement height uncertainty for the instruments.
- The uncertainty for the contribution from turbulence normalization has been handled as laid out by formula E.60. The formula is wrong since the contribution from $u_{TI}Norm$ has a different unit. This is considered to be a necessary deviation to the standard. A formal discussion within the IEC maintenance team is ongoing. A corrigendum is expected to be published.

Power Curve according to IEC 61400-12-1 Ed. 2

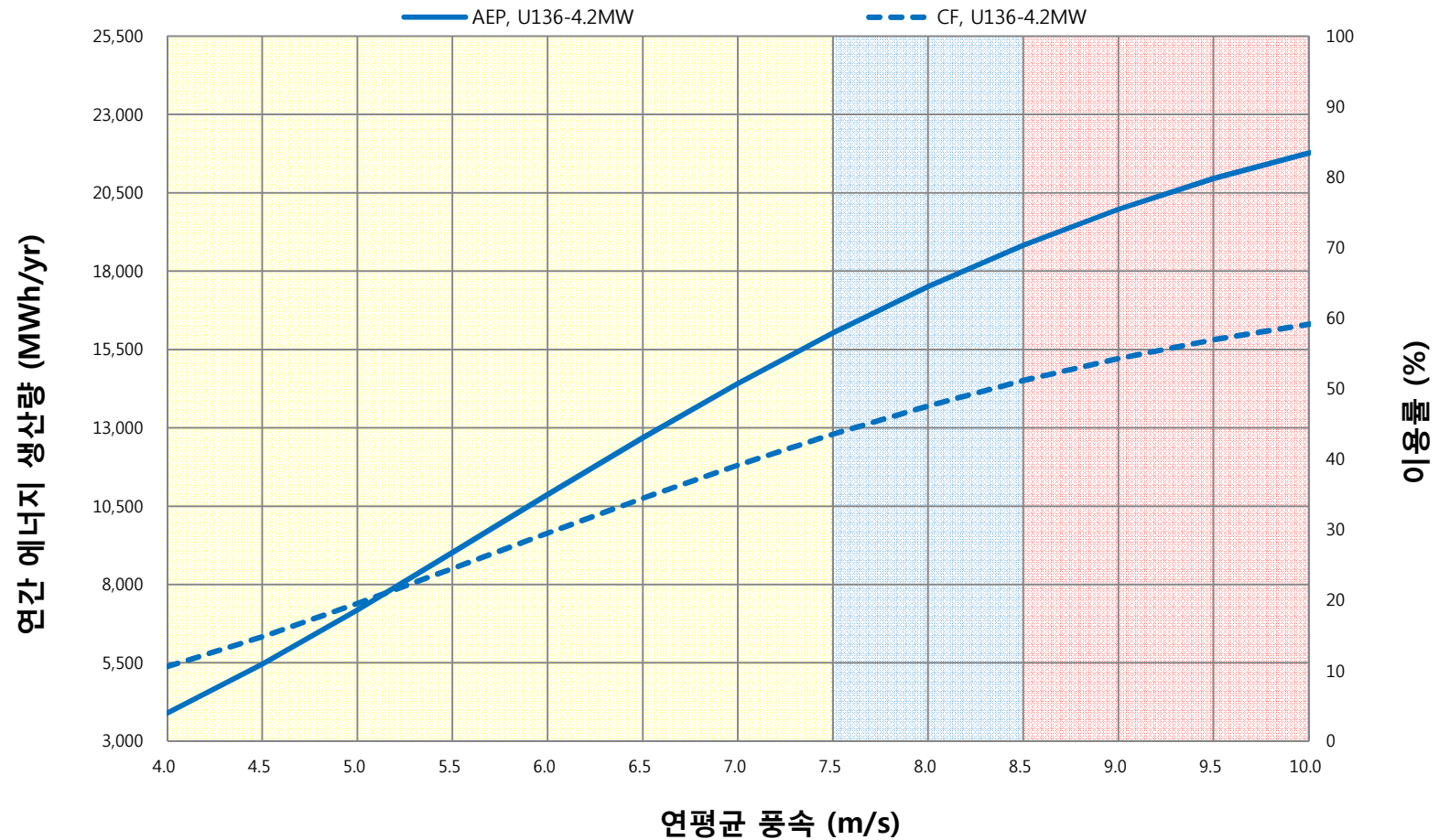


Measured power curve for standard air density 1.225 kg/m³ showing only complete bins with a minimum three data sets.

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에너지 생산량



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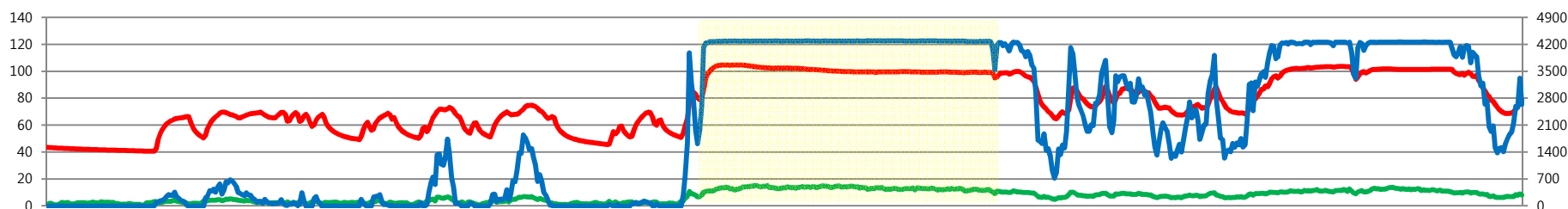


운전 이력 (2018.11.01~2019.05.30)

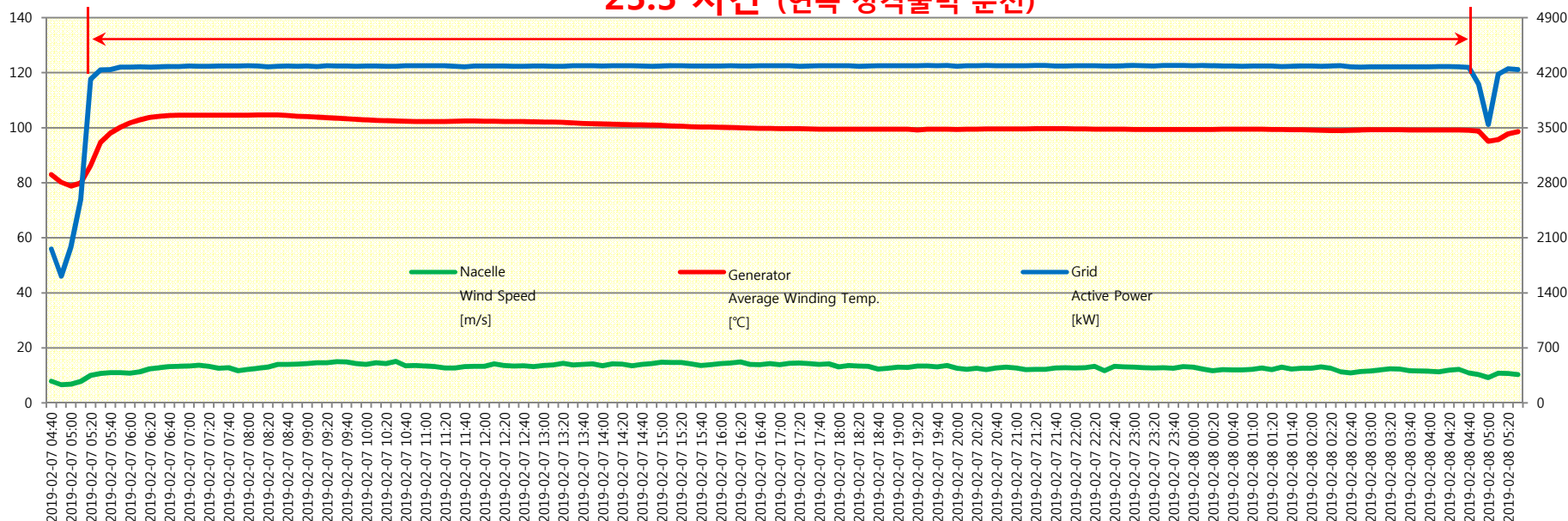
•총 운전시간: 3,200.41 h

•누적생산량: 4,563.16 MWh

• 평균가동률: 97.35 %



23.3 시간 (연속 정격출력 운전)



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형식인증서



Onshore



Offshore (RNA)

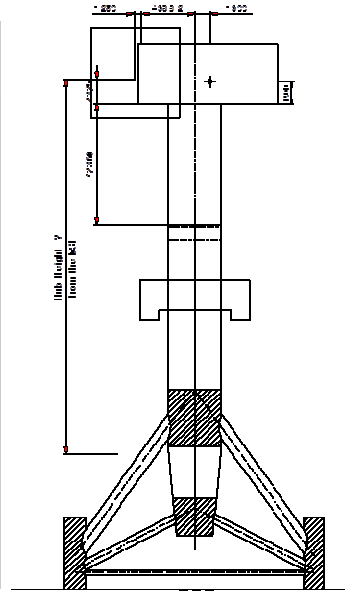
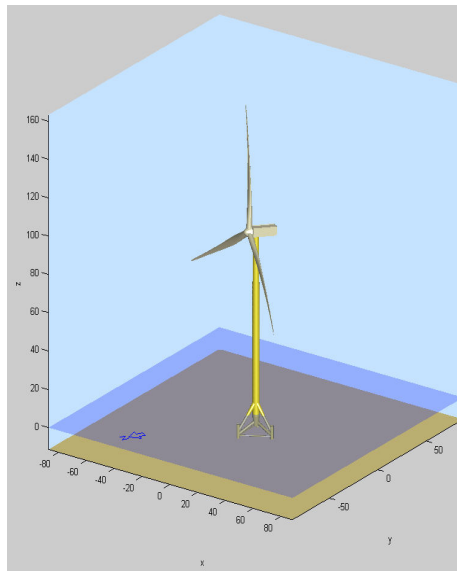
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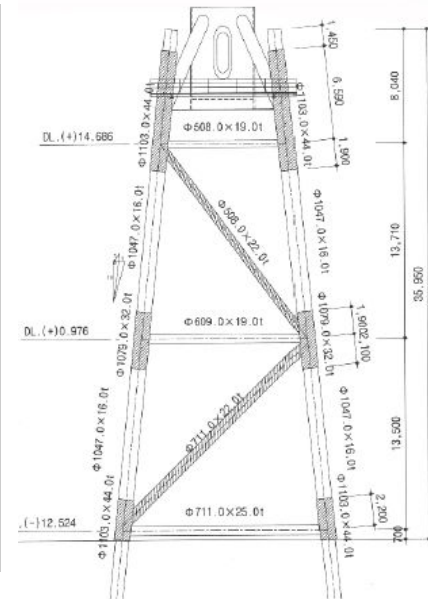
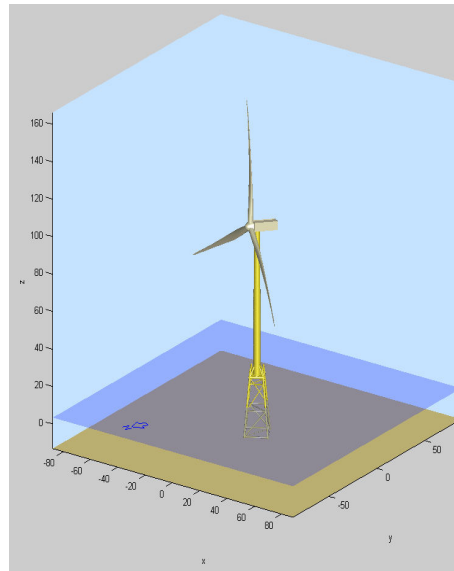
해상 적용 준비

- 하부구조물 설계 : Suction bucket(KEPCO/advact) & Jacket(POSCO)

[Suction bucket type]



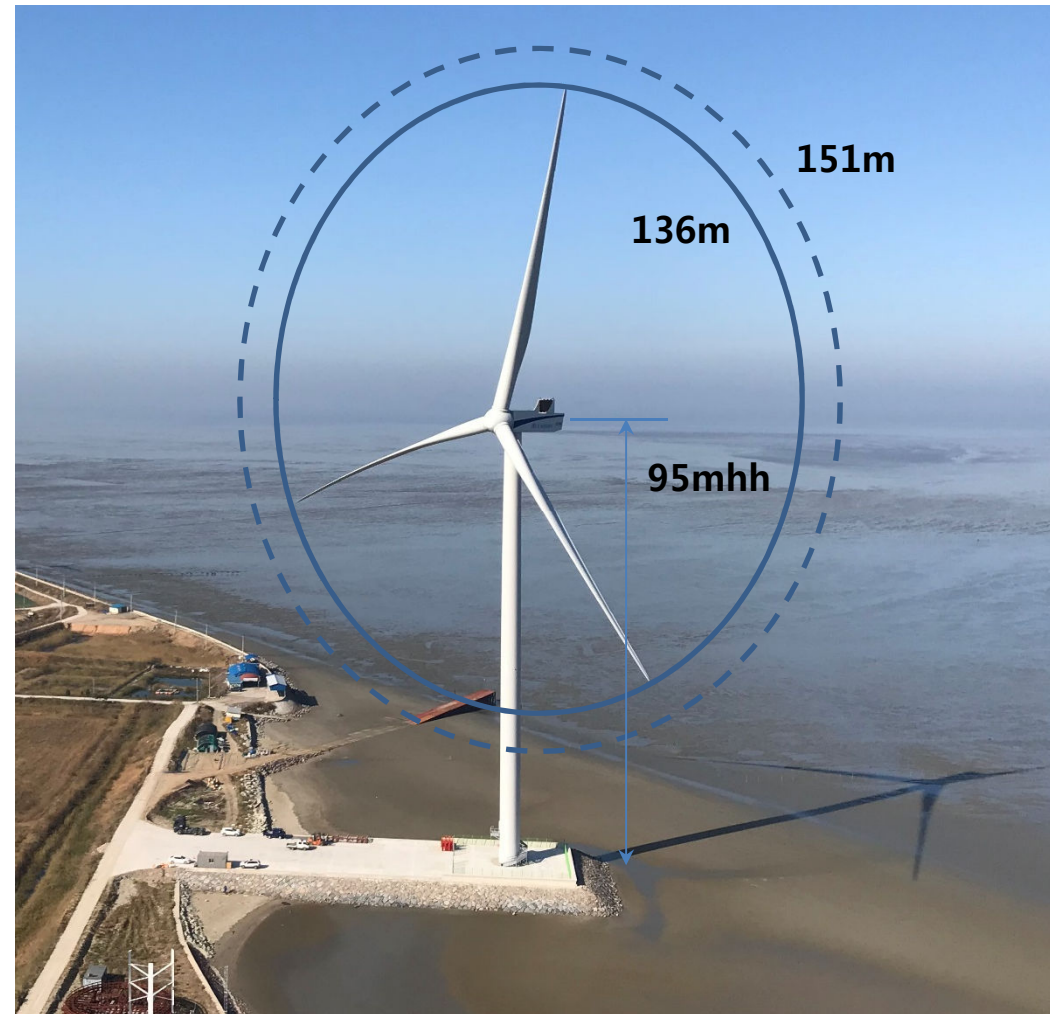
[Jacket type]



LWST 확장: U151- 4.3MW



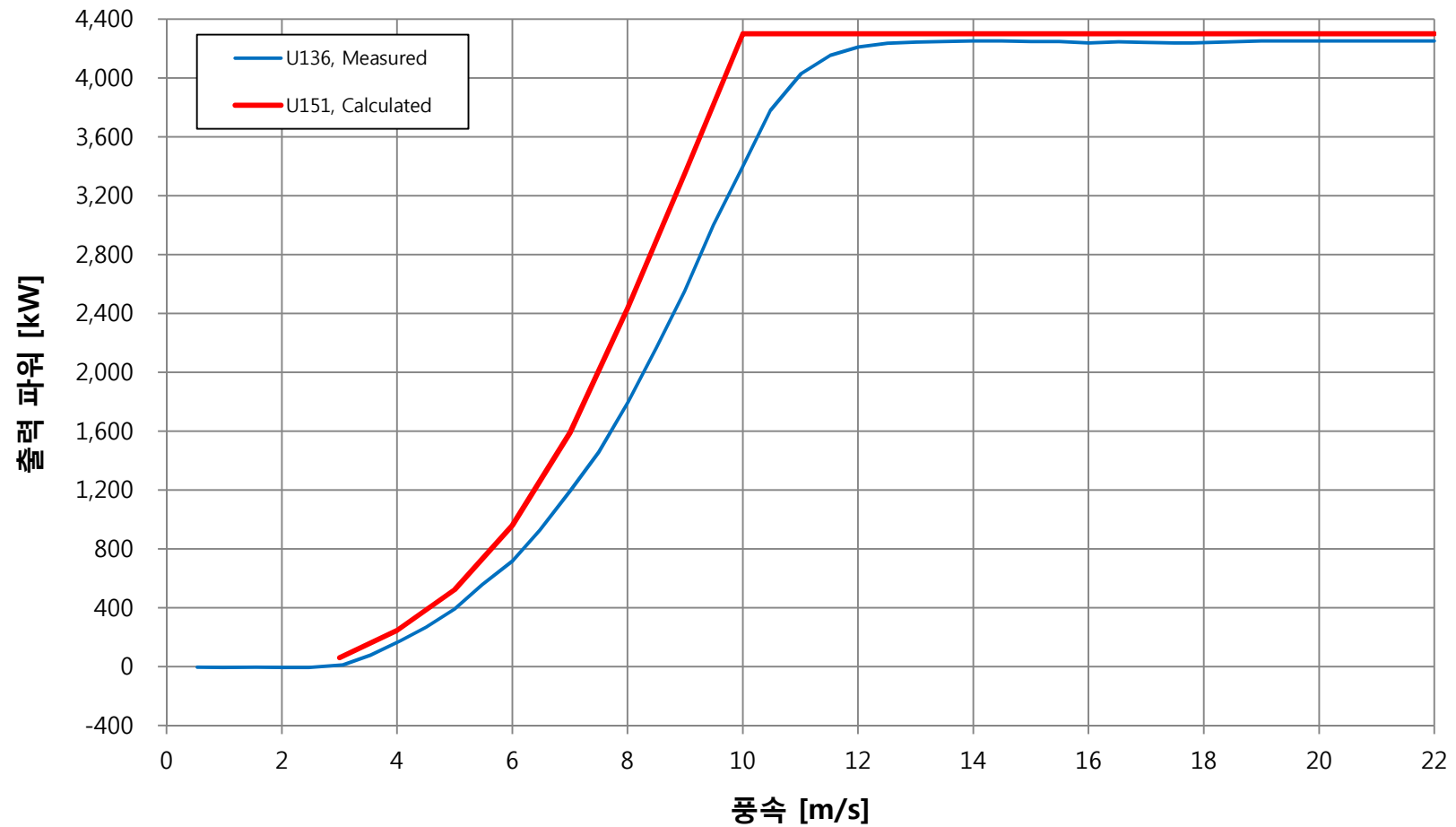
로터 직경	151 m
정격 출력	4.3 MW
설계 등급	IEC S (3A+)
블레이드 길이	74.0 m
허브 높이	95 / 117 m



LWST 확장: U151- 4.3MW



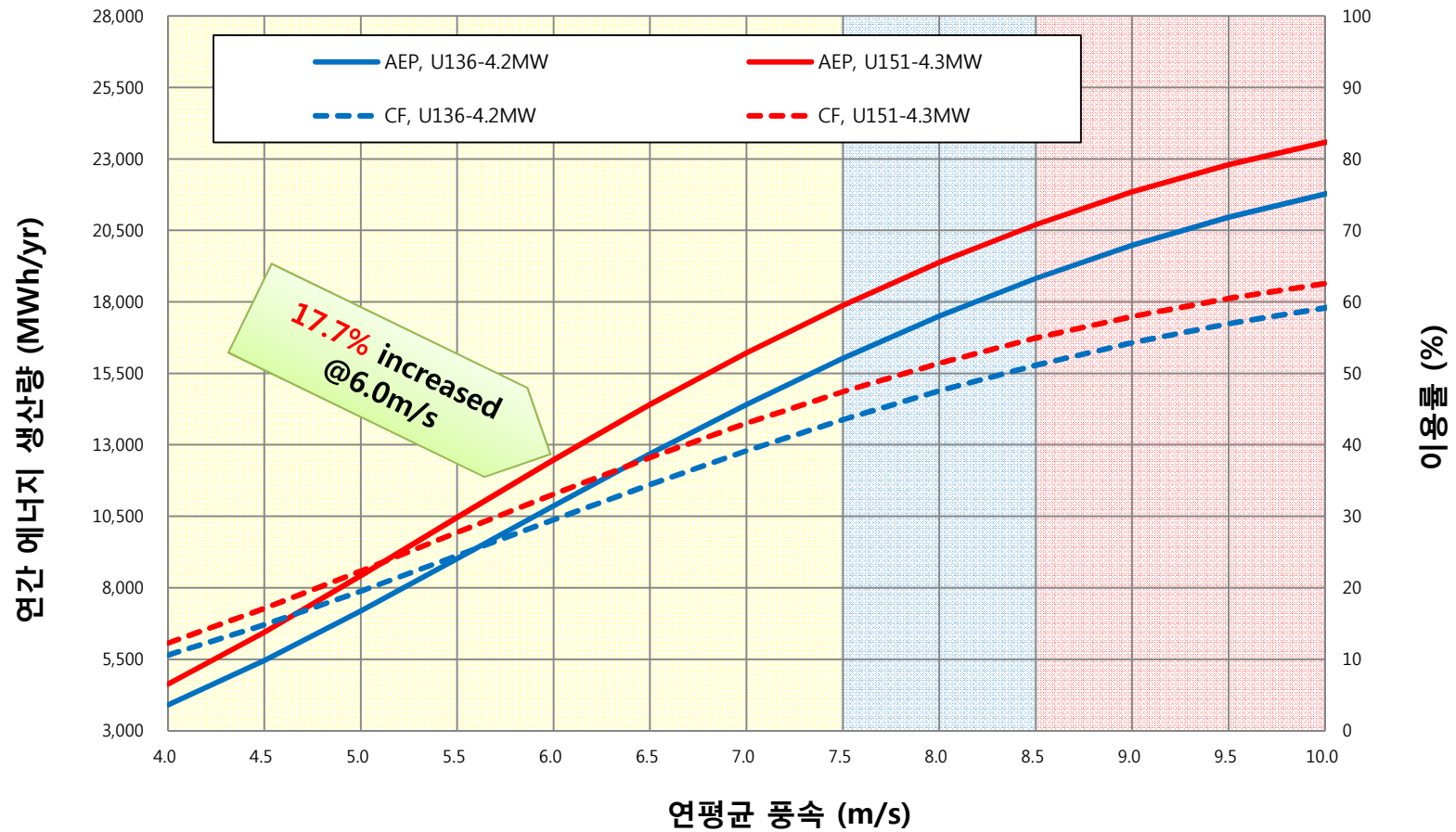
출력성능 (U136 vs U151)



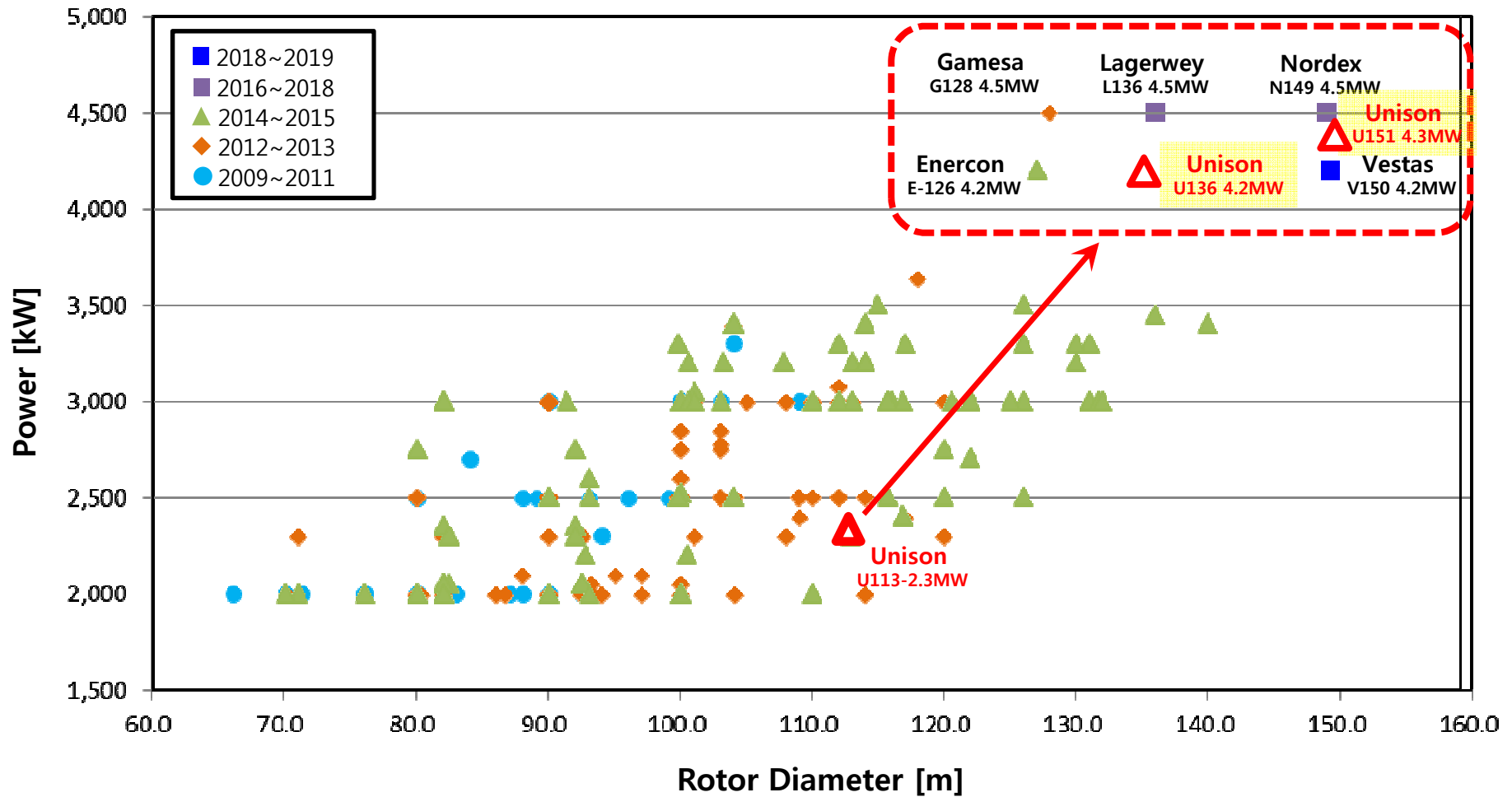
LWST 확장: U151- 4.3MW



에너지 생산량 (U136 vs U151)



육상 풍력 시장 현황 및 전망



Thank you!
감사합니다

