TITAN 200

OFFSHORE WINDPOWER SYSTEMS OF TEXAS LLC

The Future of Offshore Wind Energy is dependant on a good foundation
"The Titan 200 is Solid Footing to Build Upon"

TITAN 200 MSIP

- DEEP WATER WIND TURBINE FONDATIONS—250FT / 80 METERS
- MOBILE SELF INSTALLING PLATFORM—MSIP– NO HEAVY LIFT REQUIRED
- CAT 5 STORM CONDITIONS CERTIFIABLE TO LATEST REGULATIONS
- LEAST EVASIVE SYSTEM TO THE ENVIORIMENT– MARINE FRINDLY
- LEAST EXPENSIVE SOLUTION AVAILABLE

Titan Wind Turbine Platform

By James E. Ingle P.E.

Wind turbine foundations using piles driven into the ocean floor have been used to support wind turbines in shallow waters but these structures present many problems as the water depth increases. The Titan Wind Turbine Platform was created to economically support a single wind turbine in water depths greater than approximately six fathoms (48 feet). By using proven design methods for designing jack-up drilling rigs and using newly patented jacking technology the Titan Wind Turbine Platform was designed to incorporate many advantages. Since the Titan Wind Turbine Platform is capable of floating with the wind turbine installed on the platform and the legs retracted, the platform and wind turbine may be completely assembled and tested at the shipyard where the unit has been constructed. Then it can be towed to the predetermined location and put into service. During the transportation phase the platform must act as a barge or ship and must be designed to have adequate stability while floating with the legs in the raised position.

The shape of the hull is designed to provide stability by having the floatation compartments located at the ends of each leg of the "Y" shaped hull. The trusses near the center of the platform provide an economical structure to connect the buoyancy compartments and support the wind turbine. The size of the hull is designed to provide sufficient righting arm for stability. Transporting the platform during high waves and wind requires the metacentric height of the floating platform with the wind turbine to be higher than the center of gravity of the unit, therefore providing sufficient righting arm moments to keep the platform upright.

After transporting the platform to the desired location, the footings are flooded and the legs are lowered to the sea floor. The platform is then raised a few feet above the water surface and the preload tanks filled with water. This preloading of the footings provides a vertical force on the footings which is greater than any load generated by wind on the platform and wind turbine, waves and current. The footings are spread apart to provide sufficient stability from overturning of the platform during high wind, wave and current. When the footings have been preloaded, the fins on the bottom of the footings are immersed into the sea floor. These fins provide resisting forces to keep the platform from moving laterally.

The shape and size of the footings is very important. If the footings are too small, the footings will penetrate too far into weaker soils. If the footings are too large, the footings will not penetrate into the sea floor far enough to provide sufficient lateral resistance to keep the platform stationary. The size of the footings for the Titan Wind Turbine Platform has been determined from experience in designing footings for jack-up drilling rigs and is the proper size to function properly in most sea floor soils. After preloading the footings, the platform is raised to the desired elevation. This elevation places the bottom of the hull above any wave height for this location. The location of the footings and the weight of the platform and turbine provide sufficient stabilizing forces against the overturning forces to keep the platform from overturning.

One of the advantages of the Titan Wind Turbine Platform is that it can be moved to another site. Or, if the wind turbine requires major repairs the legs of the platform may be raised and the platform may be towed to a dock or repair yard. After the necessary repairs are made, the platform can be returned to its previous location or towed to another location. Therefore, expensive crane barges to facilitate repairs at sea are eliminated.

Wind turbine locations in shallow water are usually close to land and highly visible from land. The Titan Wind Turbine Platform is designed for deeper water depths and is intended to be located further out to sea. Therefore, they are less visible to people on shore. If the platform is placed about six miles from shore the curvature of the earth hides the platform and the tips of the wind turbine blades would be practically invisible.

The hull design shall conform to the standards of the American Bureau of Shipping and, as demonstrated by jack-up drilling rigs, have a life span of over twenty-five years. The life span of wind turbines is reported to be approximately the same length of time making the design compatible.

Since energy from wind turbines is a renewable power source, and because fossil fuels are becoming more expensive to obtain, energy from wind turbines will be in greater demand,. The Titan Wind Turbine Platform has many advantages over shallow water wind turbine platforms and can be located on larger areas of the earth.

WindPower
Systems of Texas LLC

2004 ASME-IPTI / OTC Woelfel Award for Mechanical Design

Jim Ingle (Rt) , Douglas Hines (ctr)

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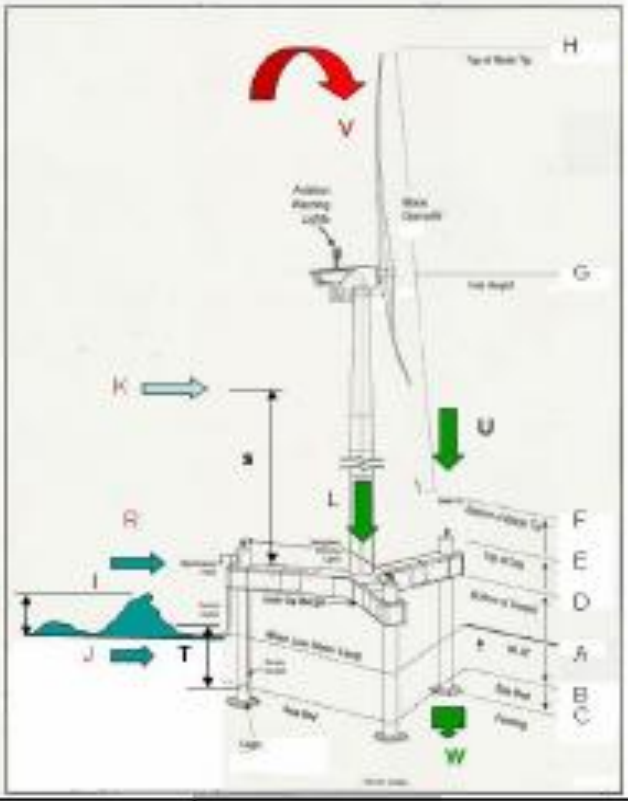
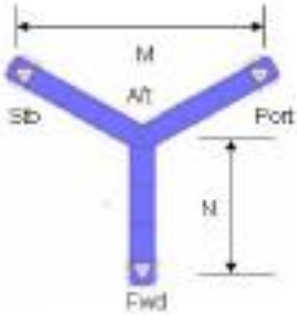
Titan 200

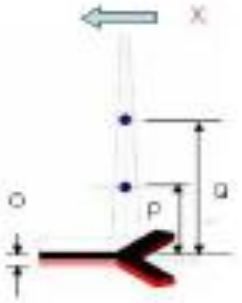
Proven Technology

Using proven oilfield techniques for platform design, the Titan 200 is capable of deployment to water depths greater than currently available, withstand the severest marine environmental loads, deploy without the use of expensive offshore heavy lift vessels.

The entire platform and turbine assembly can be moved to alternate locations or moved to port for repairs if necessary.







A- Mean Nominal Sea Level
B- water depth site
C- Leg/spud-can penetration
D- Air Gap
E- Hull Depth
F- Clearance Blade Tip
G- Hub Height from Dock
H- Top Tip Blade
I – Wave Height (100 yr)
J- Current Force (kips)
K- Wind Force (kips)
L – WI Turbine (kips)
M- Ctr. to Ctr. Legs
N – Ctr. To Ctr. Twr. To leg
O – Vessel Draft
P – Ctr. Gravity
Q – MC Height
R – Wave Force (kips)
S – Ctr. Wind Reaction
T – Ctr. Wave Reaction
U- Ballast Water (kips)
V- Overturning Moment
W – Fixity Spudcan
X – East Wind Force (kips)

Black – Known Dim.
Red – Environmental Loads
Green – Induced Loads
Blue – Calculated Values

MODEL	WATER DEPTH – FT	TURBINE - MW	"m" (ft) (1)	Wt. (Ton) (1)
T50-2.7	50	2.7	145	797
T75-3.6	75	3.6	145	797
T100-5.0	100	5	155	827
T120-3.6	120	3.6	230	927
T140-5.0	140	5	247	1052
T160-7.5	160	7.5	249	1138
T180-5.0	180	5	256	1253
T200-7.5	200	7.5	268	1338
T250-10	250	10	290	1404

Design Criteria

American Bureau of Shipping , Self Elevating MODU

IMO Resolution A.649 (16) 19898 MODU Code

Severe Temperature -10 deg C (14 deg F)

Water Temperature -0 deg C (32 deg F)

Calculations per ABS MODU Rules

SNAME TR Bulletin 5-5A

ANSI ASD 9th Edition

No marine growth or ice assumed

Dynamic amplification per DNV Class notes 31.5

Bottom soil fixity included per ABS SC-SRS

Water depth includes all tides and storm surge

Leg penetration 20 ft. assumed

All criteria subject to specific site approval

Storms are benchmark only, site specific analysis should be performed to incorporate the effects of the actual environmental data, bottom conditions and platform loading.

Offshore Wind Power Systems of Texas TITAN 200

Designed and manufactured by OWPST, the platform is an extension of years of experience within the offshore oilfield building upon the strengths of the jackup rig and platform designs. The Titan 200 provides the international offshore wind industry with proven versatile tool for the development and production of power in most world regions economically.

The TITAN 200 is classified by the American Bureau of Shipping and built in accordance with the latest MODU Code established by the IMO Resolution A.649(16).

When required by the customer, the unit can be manufactured to meet the requirements of the United States Coast guard, The Netherlands Department of Mines or other regulatory bodies.

We have been providing this same service to our clients in the offshore industry for over 30 years on a World Wide bases meeting the most stringent design requirements, we design, certify, manufacture and service

Standard Builder Furnished Outfitting

Design/certification—ABS Standard– all our designs are certified by third party as is the practice in the offshore industry. Our system is a jackup platform and ABS certifies 95% of the World jackups and we use them as our base standard.

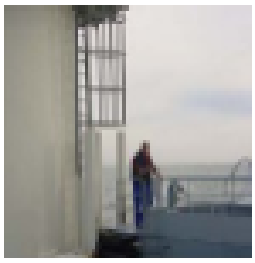
Foundation Platform (MSIP) Titan series of platforms are built to the state of the art ABS Specifications.

Job Site supervision

From basic platform to Turbine installation, to Testing and site installation and annual inspections, we provide the service you require

Aux Equipment

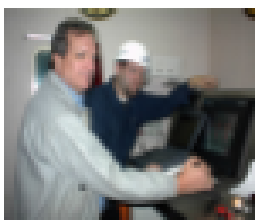
Platform Boat Lading System



As part of our package we offer several options to access the platforms. Systems that are tried and proven in the oilfields of the Gulf of Mexico, all met the offshore standards for safety regulations

"J-Tube" and Wire Cable-way through to Turbine Tower Connection

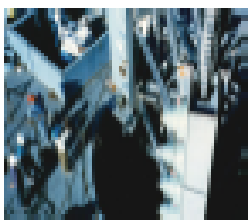
Sea floor cable is routed up the legs and wire-ways are provided thru the hull to the turbine power connections



Equipment for Installation

Marine Deployment Module

Our installation system is portable and reusable, allowing us to provide the lest expensive installation cost in the industry, controls are all marine grade, state of the art systems



Jacking System

Our patented jacking system enables us to precisely install the platform, control the elevation to with in a 1/10th of a degree of level tolerance

Power Skid Module

Machinery room includes HPU, compressed air, MCC and other subsystems to power and install the platform.

Portable Anchoring System

Marine sub-systems for vessel deployment customary equipment
Portable interconnect wiring and piping systems

Optional Builder Furnished Outfitting

Heliport

Our platforms offer the ability to incorporate small landing pads on the outboard of the leg, tied to the main structure for helicopter service.

Site Control Room

The vessel hull sections may be modified and fitted with control room equipment, for operations and monitoring of the turbines and the wind farm operations. Custom designed to the client's requirements.

Quarters

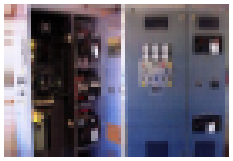
Crew quarters may be provided as a package incorporated into the hull design, with bunk, galley, rec-room and offices as a part of the platform design.

Cranes

Pedestal Cranes can be provided as an option to the equipment and installed into the main hull for servicing the platform, cranes are rated for offshore use and designed to meet the latest regulations.

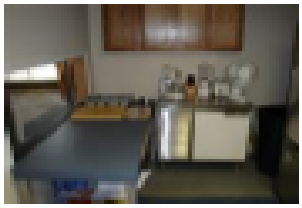
Turn-key Installation

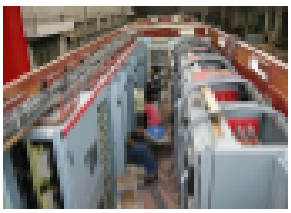
OWPST, upon the client's request, performs turn-key installation of the platform on the site, completely thru to hookup and run.



Transform and Switch Gear Module

Complete switch gear and transformer equipment modules can be incorporated into the hull design, along with PLC controls and monitoring equipment.





TITAN 200 FWSS

MSIP Salt water to Freshwater Supply Vessel / Platform

Self Powered and Self Contained

Facilities Control Room

2-4 MW Power Source

RO Modules 6 per hull sect. 44,000 Gal/day Ea.

MCC Room

Pump Room

Suction & Discharge Manifold system

Systems

- High Capacity RO Modules
- Master Pump Room
- State of the Art Control Room (PLC)
- MCC Room
- Redundant Subsystems (backup)

Continuing the design capabilities of the Titan 200 MSIP we have provided another solution to the needs of the world for fresh water supply in addition to power.

The Titan 200 FWSS platform solves the restrictions for the island states and their populist as our system is less expensive to build and install than a standard land based facility, it is less expensive to operate as the wind is the power source for the entire operation (self powered and self contain) water is produced 24/7 and all additional power that is not used by the platform is offloaded to the grid and used for alternate power requirements further driving down the cost of installation and operations of the platform.

The availability of water is only restricted by the availability of wind, which in almost all island states there is a constant wind source. Water is produced and stored on the island and the facilities that are island based such as pump stations and holding facilities are powered by the same power source.

The system is Mobile, Self-Installing and converts to a fixed Platform "MSIP"

The FWSS Platform, In addition, is Self-Powered and Self-Contained.

The system enables the user to locate the platform where it is needed, re-deployable to new sites or capable of working up to 25 years at one location. The Titan 200 FWSS Platform is "ABS Certified" to meet the latest CATS Storm Regulations.

Locally operated or remotely monitored the platform (s) may be linked together as multi-platform facilitates or used as a single platform supply.

Onboard equipment may be custom configured to enable the system to provide the precise level of quality water supply required and at the volume needed.

US Pat 7163355 and several Foreign Patents

Cost of Water Traditional vs Titan 200 FWSS

Supply Type	Water Cost	Water Cost
	To consumer $ per 1000 gallons	To family cost $ / month
Existing Traditional supply	$0.90 -$2.50	$8.40—$30.00
New Desalted Plant (land)		
Brackish water	$1.50- $3.00	$18.00—$36.00
Sea water	$3.00—$8.00	$36.00—$96.00
Titan 200 FWSS		
Sea water /Fresh water	Estimated	Estimated
Savings	60% plus	60% plus

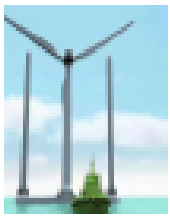
(1) Cost includes all costs to consumers for treatment and delivery.(2) Cost is based on a family of four using 100 gallons per day per person, for a total monthly use of 12,000 gallons. Cost is based on the average of the "To Consumer" cost shown.(3) Brackish is moderately salty—1000-5000mg/l total dissolved solids (TDS)(4) Seawater contains 30,000-35,000mg/l TDS(5) Cost is for typical urban coastal community in the USA . Costs for inland communities may be higher. UN published data.

Titan Wind Turbine Platforms

The Optimum Choice By Comparison

There are numerous factors which show the Titan Wind Turbine Platform is superior to all other foundations for offshore wind turbines in water depths over 50 feet. This paper discusses all the related factors, evaluates each factor and determines a relative score. The overall cost of installing and operating an offshore wind turbine is the basic consideration. Comments and discussion of each area of concern is given below and given a weighted evaluation:

COMPARISONS OF INSTALLATION REQUIREMENTS:



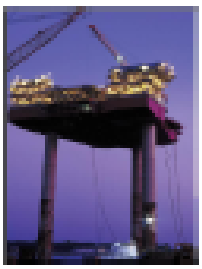
Titan Platform The design is self installing platform which will be certified as a vessel by the American Bureau of Shipping (ABS). After launching the platform, sea water is used to transport the platform. Because the Titan Platform is a vessel, transportation is accomplished by towing the platform to its assigned location for installation. As opposed to competitors, no assembly at the wind farm site is required, since it will be fully assembled with the wind turbine installed, prior to towing. Once the platform is at the site, sea water is used to install the platform. The legs of the platform are lowered to the sea floor and then ballasted with sea water downward, causing the footings to penetrate the sea floor. As the footings proceed to drive deeper into the sea floor, the vessel is raised above the normal sea level and creates an air gap between the vessel's bottom and the surface of the water. Eventually, the legs penetrate to their proper depth into the sea bed which converts the vessel into a wind generating platform for the support and normal operation of the wind turbine. Thus the vessel/platform is self installing and no heavy lift vessel is required. This jacl-up platform system utilizes a design commonly used in the oilfield for the past 50 years which is both safe and proven stable. The Titan's hydraulic jacking machinery, which is used to lower and raise the legs, is completely portable and can be removed for use on remaining platforms for a given wind farm, or reinstalled later for decommissioning or repairs from storm damage or used to adjust the platforms location to gain more efficiency for the pattern of platforms in the production of power.

Competitive Platforms Require Heavy Lift Crane Rental For Site Assembly

In the case of support equipment requirements the Titan Platform design eliminates the requirement of heavy lift vessel that are common in the offshore industry and can cost as much as $100,000.00 to $200,000.00 per day (day rate) depending on the specialty of the vessel adding a huge cost to the installation process. These vessels are weather dependant meaning that projects potentially lose scheduled days and valued installed production time (readjusted profits) for each day of delay times the number of units, these vessels are also in demand by the oilfield and not always available. Therefore high cost and a lack of dependable equipment are the consideration. Heavy lift vessels are required for moored installations, such as Spars and Pontoons as well to place anchoring structures on the sea floor and the same considerations have to be made. Generally the cost of constructing and installation of the competitive deep water platforms are two to three times that of the Titan Platform.

Competitive Platforms Transport and use of Concrete / Aggregate: Many competitive systems require their bases to be stabilized within the sea bed soil, which adds cost and time to the system and project overall. Transport vessels and weather are concerns as with all heavy lift vessels. The Titan Platform vessel and the legs it stands on are designed to penetrate the sea floor and be sable without the use of additional materials. This is common practice in the oilfield and it is not uncommon for a jack-up drilling rig to stay in one location for 5 years. The Titan Platform design requires the legs to withstand a category 5 storm and extreme conditions of various kinds. Additionally, The wind turbine platforms must be designed for a 25 year design life, which is not uncommon in the oilfield.

COMPARISONS AS TO MAXIMUM OPERATING DEPTH OF INSTALLED PLATFORMS



Titan Platform: The basic Titan Platform design is easily capable of deployment in 200 ft of water depth, which enables the turbines to operate far offshore, with the flexibility to be redeployed in its rated water depth any where in the world. In the oilfield, jack-up platforms operate in 600 ft of water and in the worst storm conditions in the world.

Competitive Platforms-Maximum Operating Depths: Almost all installed support structures throughout the world today are 60 ft or less water depth. Physics of the monopole and tripod systems limits their capabilities to go to deeper water. Moored systems that float can be installed in much deeper water but the physics of the design are limited by the platform capabilities to support a large turbine and hold an acceptable tolerance in the vertical plane.

COMPARISON AS TO ECOLOGICAL DAMAGE BY PLATFORMS

Titan Platform: The Titan Platform is the least intrusive system available and that has been proven time and time again in the oilfield as far as sea floor disturbances are concerned. We simply lower our vessel to the sea level and pull our legs from the seafloor. The later settling of the seafloor silt results in normal seafloor conditions. The Titan Platform system is the least intrusive.

Competitive Platforms Cause Ecological Damage to the Sea Floor/Nature of Damage/Impact on Nearby Fishing: In all cases of the sea floor foundations there will be some sort of damage. The systems that use concrete and aggregate normally cause the most damage and are the most difficult and costliest to cleanup. Blasting structures out of the sea floor and removal by heavy lift vessels are required by practice and by regulators, which causes damage to the sea bed and destruction of sea life. In most cases the structures attract wildlife of all kinds but being the least intrusive should be the goal.

COMPARISON AS TO STABILITY OF THE PLATFORMS

Titan Platform: The Titan Platform is stable and designed to meet the requirements of the regulating authority such as MMS of the US government. It will pass third party evaluation to the same standards used for drilling and production operation throughout the world. The Titan Platform is able to withstand a CAT 5 storm and continue operations after inspection of the turbine equipment. On a everyday bases the Titan is able to adjust and hold a tolerance of +/- 0.01 in the horizontal plane by means of adjusting the elevation between leg heights from the water line which is monitored and measured dynamically at the time of installation.

Competitive Platforms Lack Necessary Stability: Stability is the key to the performance of the wind turbine and therefore the production of power and resulting profits. If the platform is fixed to the bottom seafloor directly and if it is designed to withstand a severe storm condition and have the support tower of the turbine remain in its original manufactures specified vertical position, then this is what is required. Unfortunately, a ridged vertical position for monopoles and tripods require deep penetration of piles to accomplish this rigidity, typically 3 times the water depth below the sea floor and are also limited to

COMPARISON OF SEA FLOOR PREPARATIONS FOR PLATFORMS

Titan Platform: The Titan Platform is designed to deal with these conditions, in fact all jack-ups are designed to deal with the worst of sea floor conditions, uneven surfaces; legs are off-set in elevation, soft bottom conditions; the feet of the legs are deigned with additional area to cause them to penetrate to the proper depth. If there are obstructions below the surface we simply rotate the platform to provide a reorientation of the legs and reinsert them into the sea floor on the same centerline for the turbine.

Competitive Platforms Face Difficulties Depending on the Sea Floor: For all sites the sea floor must be surveyed to determine the conditions and not all areas are flat and stable soil conditions. In fact most sea floors are not flat. These conditions cause additional expense in installation costs for virtually all other designs with the exception of a jackup design. Uneven sea floor conditions do not allow a foundation to be simply placed on the sea floor. Finding a flat surface or preparing one, which is a hard task in 100 ft of water or basically at any depth. Gravity foundations all require site soil modifications which is added cost. TLP and moored systems need a flat surface to work from for even load distribution at the surface in tensioning the cables to be able to hold the tolerances required. Monopoles and tripods being driven deep into the soil have problems as well in that typically it is not know what is below the sea floors surface. Rock and debris cause installation problems, caves cause stability problems. Additionally, if the spacing or distance between turbines for the overall farm changes due to the bottom

COMPARISONS OF PLATFORM STORM CAPABILITIES.

Titan Platform: The Titan "jackup" design allows for such conditions to occur and survive. Rigs have operated in the North Sea everyday for the last 50 years under these conditions by raising the platform height to a known maximum clearance or "Air Gap" between the normal sea level and the worst storm conditions known for that area based upon records. Waves pass under the platform not through it, the legs are designed to withstand the force of the wave and provide the least amount of exposure in area to the wave to reduce the effects of the wave. Wind is considered in the loads in the design phase as well so that the combination of the weight and distance between legs will resist any predetermined overturning moment loads. The legs are always in compression, loaded downward.

Competitive Platforms Have Design Problems and Greater Costs Based upon the recent storm damage in the Gulf of Mexico and the resulting rule changes within MMS in Washington DC, the requirements for support structures are becoming much more robust. The requirements of survival of a CAT 5 storm of the structure will require stronger overall structures, which mean more cost; Monopoles and tripods will face the greatest problems in this area as they are marginal in design even in 60 ft of water depth. When wind loads and wave loads go up, then the cost goes up proportionally. MMS is now requiring a 50 ft wave consideration in the design before approval to deploy a site, which means more steel and more cost. Floating structures, TLP and moored systems will be under water in all design cases like these and the tensioning systems must be able to survive the buoyant loads of 50 ft waves and the unloading of the tension system in the trough of the wave as well and then the reversal of the load as the wave comes back.

Titan 200

"MSIP"– Mobile Self Installing Platform

Wind Farm Site Location Assembly

Platform Prefab Components

Assemble Platform in Local Yard

Skid to Launch Barge

Ballast Down Launch Barge

ABS lift Test at Assy. Area

Tow to Site

Site Installation & Commissioning

Ballast Water "PreLoad"

Legs Touch Sea Floor

Legs Penetrate Sea Floor

Remove Ballast Water

Raise the Platform

Installed Power Ready

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