Weather Launch Console and Jobs

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NASA'S MISSION

NASA's mission is to
pioneer future space exploration, scientific discovery, and aeronautics research.

Your job is to support the mission of NASA, and specifically to support the Space Operations Mission Directorate. Your number 1 priority is to keep everyone involved safe.

WEATHER SHUTTLE TRAINING

In the reading overview you covered a lot of information. Now you will see how each part of the weather console is used to monitor the weather and what each job entails.

Weather at the Launch Pad is monitored by the 45th Weather Squadron

at Patrick Air Force Base

near Melbourne, Florida

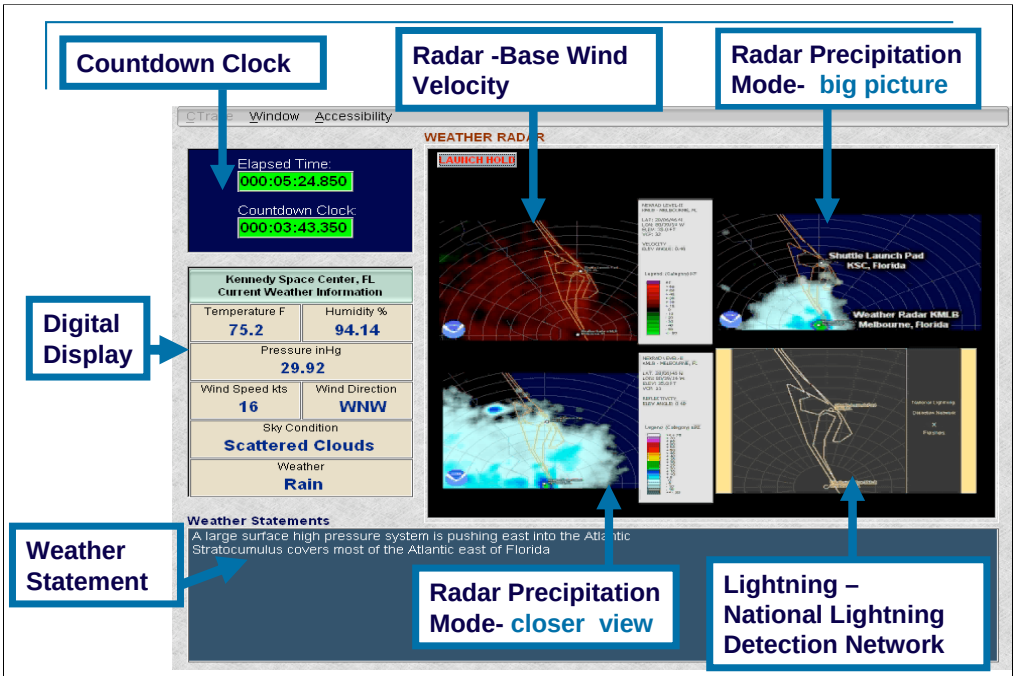

Purpose of 45 Weather Squadron Shuttle Training:
Educate forecasters and new launch weather officers on Shuttle operations so they can provide expert weather support and products to the Space Shuttle Program

Pad Operations

Pad Ops Constraints:
Generally
(Shuttle not necessarily on pad)

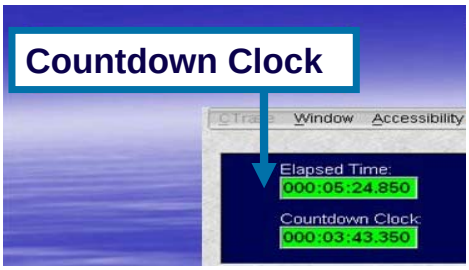
- LTG within 5NM
- Wind>17Kts (many thresholds)
- Heavy Precipitation
- Hail–any
- Cold Temperatures
- Severe Weather

Weather Constraints covered by 45 WS wx warnings/advisories



Weather Console

ALL WEATHER LAUNCH SPECIALISTS



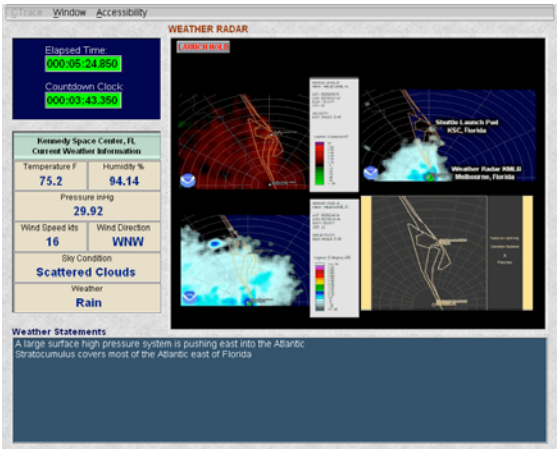
You must watch the countdown clock!

You are at Launch -20 minutes when the countdown starts. It is crucial that you enter your data for EVERY minute before the launch to ensure the safety of those aboard the shuttle!

LAUNCH DATA SHEET EXAMPLE

Launch Clock 	Does the Cloud Radar permit Launch?	Does the Precipitation Radar permit Launch?	Does the Precipitation Digital Display permit launch?	Does the Temperature and sky conditions permit launch?	Does the Air Pressure permit launch?	Do the wind conditions permit launch?	You must have yes all columns to permit launch. Launch Permit/ hold/ scrub?
Example	yes	yes	10 nautical miles	yes	yes		Permit
Launch - 20							
Launch - 19							
Launch - 18							
Launch - 17							
Launch - 16							

Weather Console and the Launch Commander



The Launch Commander monitors all of the data from the screens in order to know ultimately if the launch is a go or no go. The launch commander needs to be calm under pressure and able to keep up with a lot of information.

Launch Commander Data Sheet

LAUNCH COMMANDER

Big Question: Will the weather permit the Space Shuttle to launch?

As the Weather Launch Commander you are in charge of verifying all data from the console, and verifying that it is correct. You may want to choose assistants to help you with these tasks, but ultimately you are responsible for saying "yes" or "no" when it's time to launch!

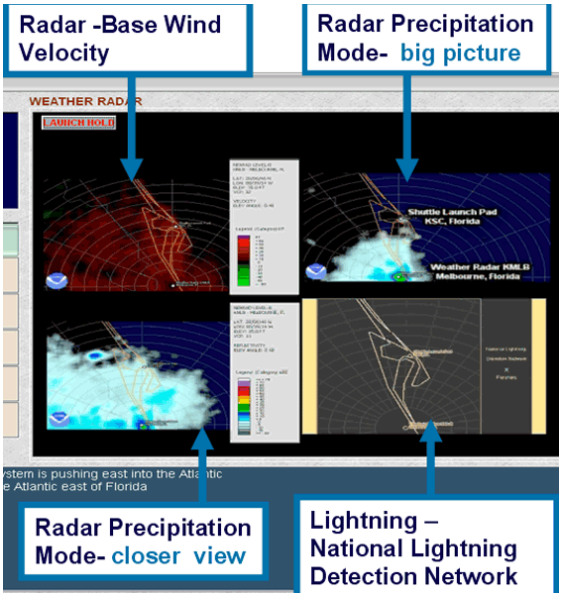
Pre-Launch Work

- Study the pictures of the weather display screen to verify the data you are receiving from the weather specialists.
- Complete all of the worksheets for each console so that you will know if the weather data is accurate when your technician gives it to you to review.

Launch Tasks: Look at all the messages that you receive about the weather and write yes or no for launch based on the information you receive. . Your evaluation of the information will determine whether the weather conditions will permit, delay, or scrub the launch.

- Identify the weather condition(s) that cause a delay or warning that could delay or stop the launch.
- Identify the weather condition(s) that could delay or stop the launch.
- Monitor the Weather Displays during the launch, do not take anyone else's word that it is a go.
- Accurately record the data on your Launch Commander Checklist for each minute in the 20 minute launch countdown. You must make sure that there are yeses in all of the columns to permit the launch.

WEATHER CONSOLE AND RADAR



There are Four Screens in the RADAR Window

Radar-Based Wind Velocity
That tracks the wind speed in kts (nautical miles) and direction of the wind.

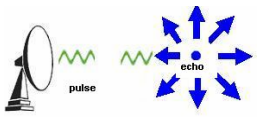
Radar Precipitation Mode
Which is in two screens one is further out than the other. Both Track cloud cover and precipitation.

Lightning
As it looks on the National Lightning Detection Network

DOPPLER RADAR

The most successful tool to detect precipitation is radar. Radar stands for RAdio Detection And Ranging. Radar has been used to detect precipitation, and especially thunderstorms, since the 1940's.

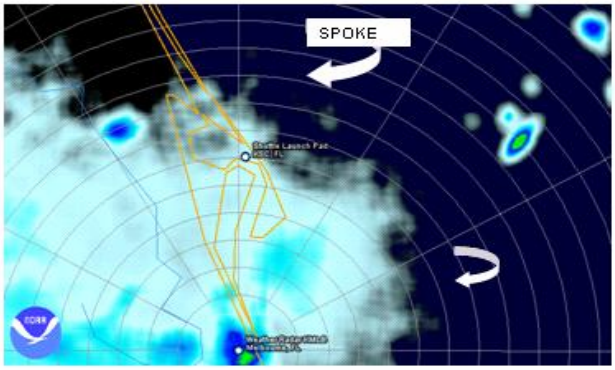
The radar used by the National Weather Service is called NEXRAD or Nexrad (Next-Generation Radar) Its technical name is WSR-88D, which stands for Weather Surveillance Radar - 1988 Doppler (the prototype radar was built in 1988). As its name suggests, the WSR-88D is a Doppler radar, meaning it can detect motions toward or away from the radar as well as the location of precipitation areas. NEXRAD detects precipitation and wind.



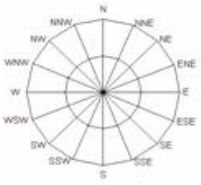
Spokes and Range Rings on a Radar Image

How to read direction and distance using

- **Legend to understand the radar image: When you are charting speed and direction use the spokes and range rings.**
- **The Radar is sent from the Melbourne NWS Station.**



1. **The range rings start 10 miles from Melbourne moving out toward the KSC Launch Pad.**
2. **There are five (5) miles between each range ring.**
3. **The spokes provide direction of the weather**

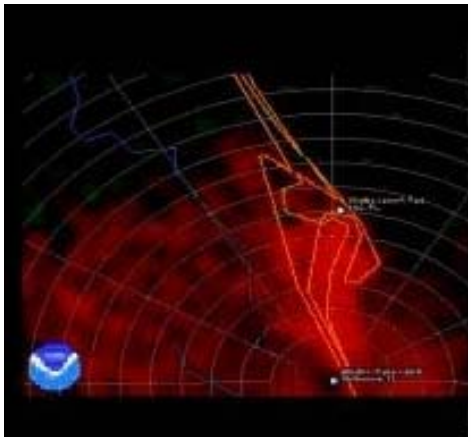


RADAR-BASED WIND VELOCITY

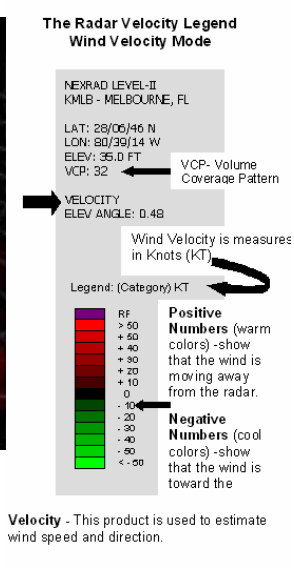
On this screen the color indicates wind direction

- Red – wind is moving away from the radar
- Green- wind is moving toward the radar

show the KTs per hour- or how many nautical miles per hour the wind is moving.



The example above shows the wind at the launch pad is about 50 KTs per hour moving away from the RADAR at the center of the range rings.



USER LAUNCH WIND CONSTRAINT

DO NOT launch if peak winds exceed wind criteria (60')

- Peak Wind Speed range: wind is >36 mph, depending upon direction

Wind Dir (deg)	Wind Spd (Kts)
000 - 001	
002 - 004	
005 - 009	
010 - 016	
017 - 043	
044 - 050	
051 - 055	
056 - 058	
059 - 062	23
063 - 064	24
065 - 067	25
068 - 069	26
070 - 071	27
072 - 073	28
074	29
075 - 076	30
077	31
078	32
079	33
080 - 100	34
101 - 110	31
111 - 120	30
121 - 134	29

36 MPH

Wind Dir (deg)	Wind Spd (Kts)
135 - 140	28
141 - 152	27
153 - 157	26
158 - 163	25
164 - 196	24
197 - 202	25
203 - 223	26
224 - 229	27
230 - 233	28
234 - 236	29
237 - 239	30
240 - 241	31
242 - 244	32
245 - 340	34
341	33
342	32
343	31
344 - 345	30
346	29
347 - 348	28
349 - 350	27
351 - 352	26
353 - 355	25
356 - 357	24
358 - 359	23

Weather Technician for Wind-Based Velocity Radar

Big Question: Based on the wind speed and direction will the weather clear the launch pad and the flight path in time to launch?

As the Weather Technician for the Wind-Based Velocity Radar you are in charge the wind speed and direction at the launch pad and predicting whether the launch is a go or no go based on the wind speed and direction.

Perhaps you noticed that the wind both on the radar and in the Weather Launch Commit Criteria are in KTs and the range rings are calculated in MILES. You will need to calcuate the KTS into Miles in order to know if the weather will clear the pad in time for the launch.

Pre-Launch Work

- Study the spokes on the RADAR and learn to calculate distance and speed and direction using the radar screen.
- Practice using the Wind Speed Data Radar Sheet sheet before the launch so you will be confident at launch countdown in your job.

Launch Tasks: Use the weather data from the wind speed conversion sheet to look at the radar to determine if the weather will clear the launch pad and the flight path in time to launch.. Share your information with the meteorologist to determine whether the weather conditions will permit, delay, or scrub the launch.

- Identify the weather condition(s) that cause a delay or warning that could delay or stop the launch.
- Identify the weather condition(s) that could delay or stop the launch.
- Monitor the Wind-Based Velocity Radar during the launch.
- Convert kph to mph calculate the wind direction, the use the radar and the weather spokes to determine if the weather will clear the launch pad and the flight path in time to launch .Don't take anyone else's word that it is a go.
- Accurately record the data on your launch sheet for each minute in the 20 minute launch countdown. You must make sure that there are yeses in all of the columns to permit the launch.

RADAR-BASED PRECIPITATION DISPLAYS

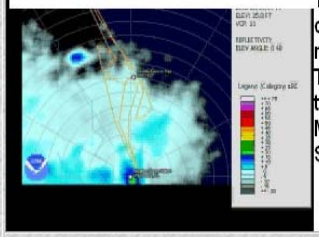
WEATHER RADAR

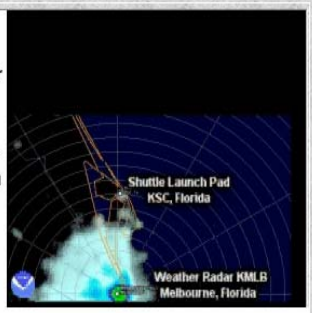
RADAR in precipitation mode

shows clouds and indicates weather activity inside the clouds.

White and cool colors with negative numbers indicate transparent or thin clouds. Greens, yellows, and reds (positive numbers) indicate precipitation.

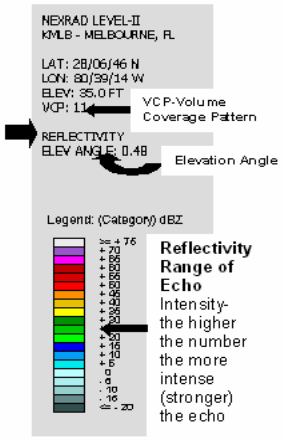
The higher the number the more intense the weather activity within the clouds.





This radar image shows cloud cover. The green area is the energy of the dust, bugs, etc that is close to the radar at Melbourne NWS (KMLB). The blue and white further away is the cloud cover between Melbourne's radar and Kennedy Space Center.

The Radar Reflectivity Legend Precipitation Mode



Reflectivity
A display of echo intensity measured in **dBZ**. This legend describes data detected for precipitation, evaluating storm structure locating boundaries and determining hail potential.

dBZ stands for decibels of Z. It is a weather measure of equivalent reflectivity (Z) of a radar signal reflected off a remote object.

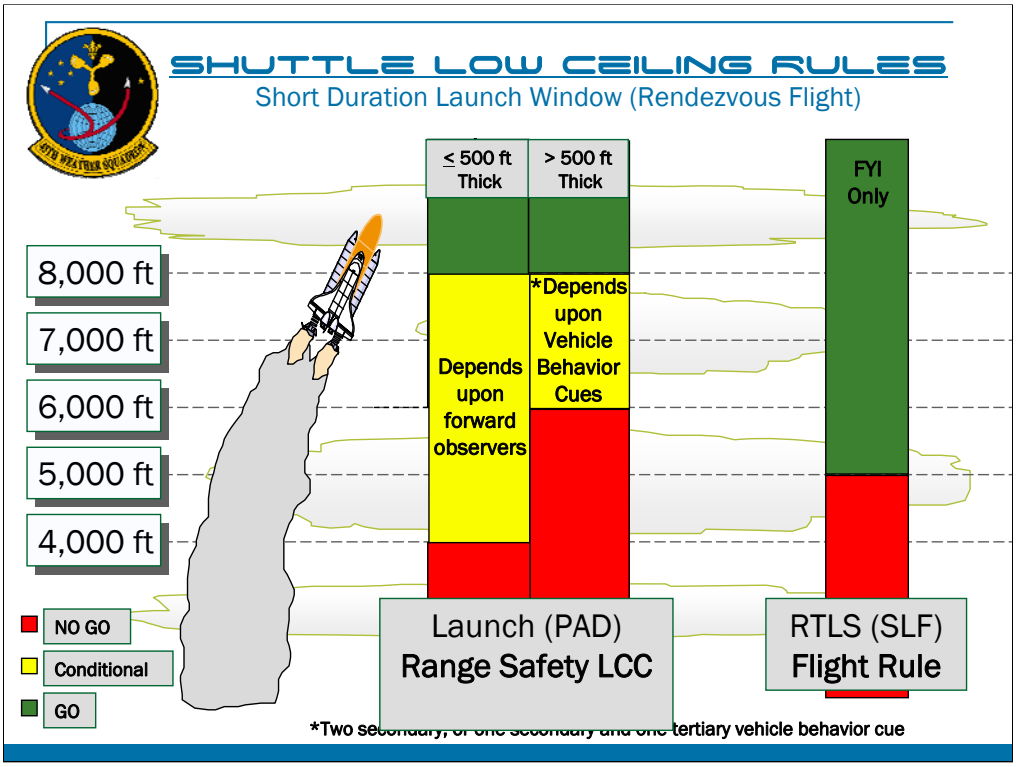
CEILING DEFINITION

Ceiling: Lowest cloud deck over 50% coverage

- Overcast (OVC)
  - 8/8 coverage
- Broken (BKN)
  - >4/8 – <8/8 coverage

Ceiling

- Scattered (SCT)
  - 3/8 – 4/8 coverage
- Few (FEW)
  - Trace – 2/8 coverage
- Sky Clear (SKC)
  - No clouds coverage


SHUTTLE LOW CEILING RULES
Short Duration Launch Window (Rendezvous Flight)
≤ 500 ft Thick
> 500 ft Thick
FYI Only
8,000 ft
7,000 ft
6,000 ft
5,000 ft
4,000 ft
Depends upon forward observers
*Depends upon Vehicle Behavior Cues
NO GO
Conditional
GO
Launch (PAD)
Range Safety LCC
RTLS (SLF)
Flight Rule
*Two secondary, or one secondary and one tertiary vehicle behavior cue

Weather Technician for Radar-Based Precipitation/Clouds

Will clouds stop the launch?

As the Weather Technician for the RADAR-Based Precipitation you are in charge monitoring the clouds' thickness, intensity of activity, and distance from the flight path. The Digital Display will show clouds, but you need to be aware of what the RADAR tells you. Thick clouds, precipitation, and thunderstorms can scrub the launch.

Pre-Launch Work

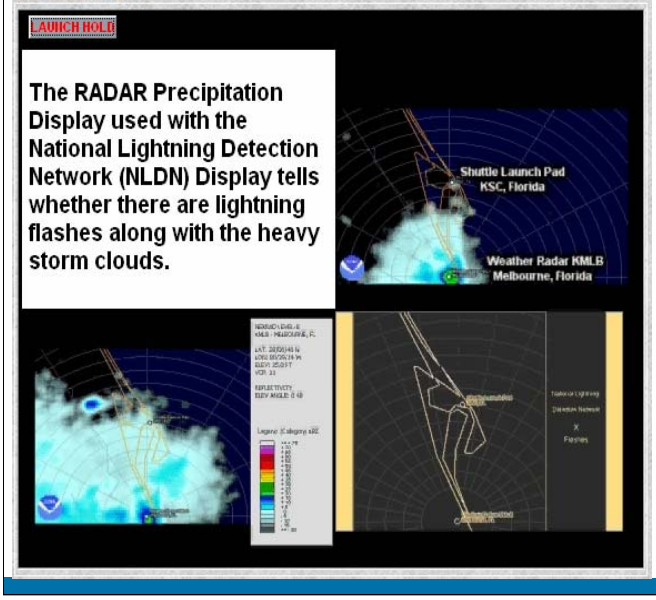
- Study the spokes on the RADAR and learn to calculate distance and direction using the radar screen. Learn to read the colors and thickness of the clouds by looking at the radar.
- Practice using your Clouds Radar Data Sheet before the launch so you will be confident at launch countdown in your job.

Launch Tasks: **Clouds:** Does the digital display show that there are clouds? If yes, look at the radar to fill in the chart. . Share your information with the Meteorologist to determine whether the weather conditions will **permit**, **delay,** or **scrub** the launch

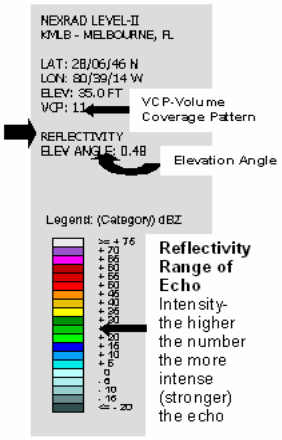
- Identify the weather condition(s) that cause a delay or warning that could delay or stop the launch.
- Identify the weather condition(s) that could delay or stop the launch.
- Monitor the RADAR-Based Precipitation Screens and the National Lightning Detection Network display during the launch.
- Accurately record the data on your launch sheet for each minute in the 20 minute launch countdown. You must make sure that there are yeses in all of the columns to permit the launch.

RADAR-BASED PRECIPITATION AND LIGHTNING DISPLAYS

WEATHER RADAR



The Radar Reflectivity Legend
Precipitation Mode



Reflectivity
A display of echo intensity measured in **dBZ**. This legend describes data detected for precipitation, evaluating storm structure locating boundaries and determining hail potential.

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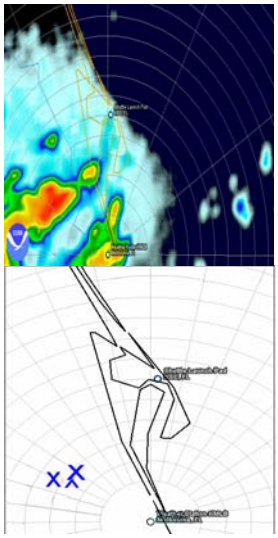
The National Lightning Detection Network NLDN Display

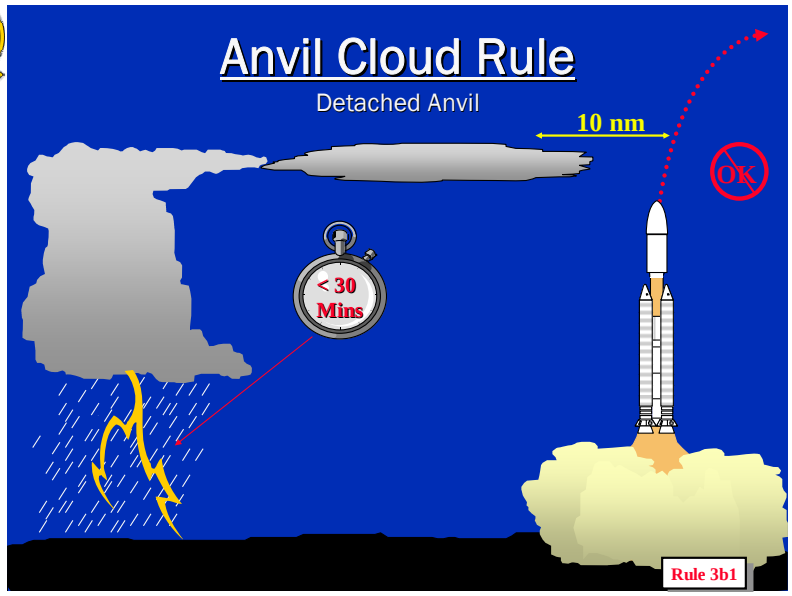


You can see warm/hot positive colors in this radar image. These mean there is strong precipitation and perhaps lightning.

Use the Lightning Display to compare the flashes of lightning to the radar image of the thunderstorm.

The blue "x" shows a lightning flash on the The NLDN Display shows where lightning flashes are detected in this thunderstorm.

Once again, you can calculate the distance by using the range rings in the spokes.



Do not launch if the flight path will carry the launch vehicle through or within 10 nautical miles of a nontransparent part of a detached anvil cloud for the first 30 mines after the last lightning discharge in or from the parent cloud or anvil before detachment or after the last lightning discharge in or from the detached anvil cloud after detachment.

ANVIL/VAHIRR

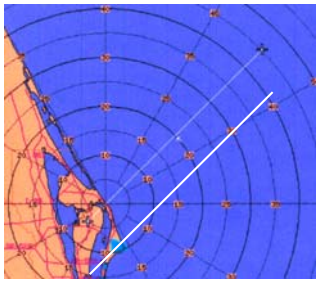
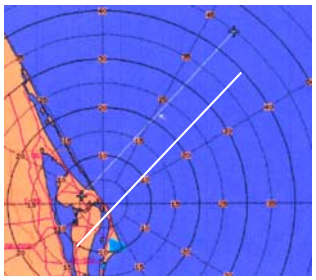
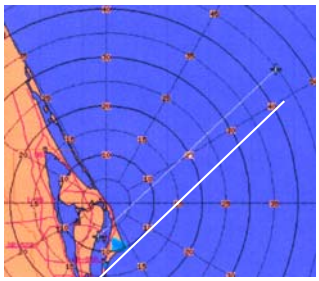
- Determine max dBZ allowed
  - The rule states that you must not exceed 33dBZ-kft
  - Divide 33 by the avg thickness (kft), the dividend will be the maximum dBZ reflectivity allowed in the anvil
    - In our example divide 33 by the average thickness, 4,000' or 4kft, = 8.25dBZ
    - This is the threshold for that anvil that cannot be exceeded

Avg Anvil Thickness	Max dBZ Allowed
1,000 (1kft)	33.00
2,000 (2kft)	16.50
3,000 (3kft)	11.00
4,000 (4kft)	8.25
5,000 (5kft)	6.60
6,000 (6kft)	5.50

Avg Anvil Thickness	Max dBZ Allowed
7,000 (7kft)	4.71
8,000 (8kft)	4.13
9,000 (9kft)	3.67
10,000 (10kft)	3.30
11,000 (11kft)	3.00
12,000 (12kft)	2.75

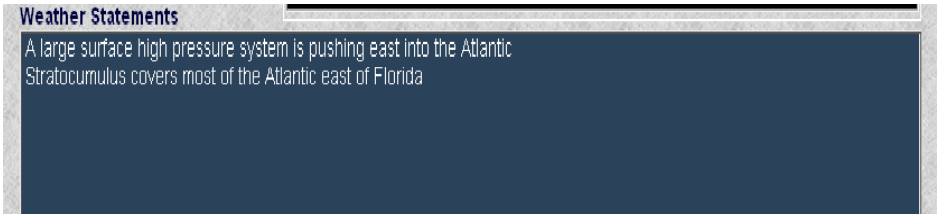
ANVIL CLOUDS/THUNDERSTORMS

- Determine if you exceed max dBZ allowed
  - Look at cross-sections for the flight path as well as 3nm left and right of the azimuth until you are clearly convinced you have located the maximum reflectivity

CHECKING CLOUDS

Weather Statements give you information that help you to be sure you are accurately reading cloud cover.



The statement above tells you that there is a high pressure system pushing through. And Stratocumulus clouds cover most of the Atlantic east of Florida.

What weather would you expect?

Weather Technician for Radar-Based Precipitation and NLDN Displays

Big Question: Is it raining on the launch pad or in the flight path?

As the Weather Technician for the Wind-Based Velocity Radar you are in charge the wind speed and direction at the launch pad and predicting whether the launch is a go or no go based on the wind speed and direction.

Pre-Launch Work

- Study the spokes colors on the Base Reflectivity Chart and the Intensity of precipitation by color and decibels (dBZ)
- Practice using your Precipitation Radar Data Sheet before the launch so you will be confident at launch countdown in your job.

Launch Tasks: Radar Precipitation: Fill in the weather data on the data-recording sheet from the Radar Display. *To launch there can be no precipitation at the launch pad or within the flight path*. Share your information with the Meteorologist to determine whether the weather conditions will permit, delay, or scrub the launch.

- Identify the weather condition(s) that cause a delay or warning that could delay or stop the launch.
- Identify the weather condition(s) that could delay or stop the launch.
- Monitor the Wind-Based Velocity Radar during the launch.
- Convert **kph** to **mph** calculate the wind direction, the use the radar and the weather spokes to determine if the weather will clear the launch pad and the flight path in time to launch. , do not take anyone else's word that it is a go.
- Accurately record the data on your launch sheet for each minute in the 20 minute launch countdown. You must make sure that there are yeses in all of the columns to permit the launch.

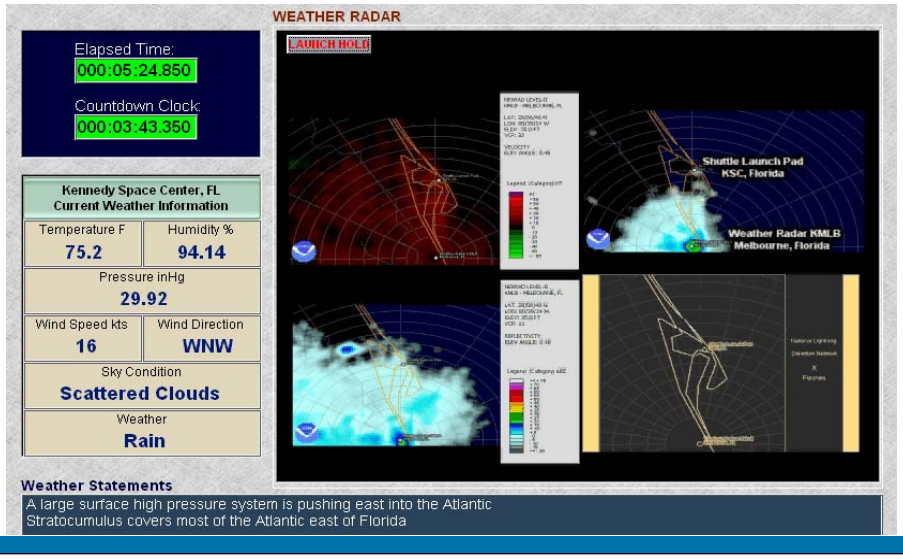
THE DIGITAL DISPLAY

The Digital Display tells you the current temperature, humidity, pressure, wind speed and wind direction, as well as the conditions of the sky.

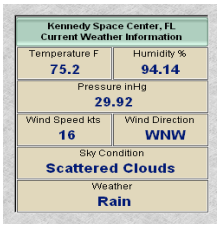
Kennedy Space Center, FL Current Weather Information	
Temperature F 75.2	Humidity % 94.14
Pressure inHg 29.92	
Wind Speed kts 16	Wind Direction WNW
Sky Condition Scattered Clouds	
Weather Rain	

This information is gathered by the weather balloons and relayed to the display for you to be able to analyze current launch sky conditions.

What does the digital display tell you about the weather information on the rest of the weather console?



USING THE DIGITAL DISPLAY



Big Questions to be answered using the Digital Display are:

1. Will the temperature meet the Launch Commit Criteria for the shuttle launch?
2. Is the barometric pressure rising or falling?
3. Do wind speed and direction and barometric pressure help predict weather conditions?
4. Based on the wind speed will the wind be within launch constraints?
5. Is it raining on the launch pad or in the flight path?

TEMPERATURE

- Temperature is the measure of how hot or how cold the air is.
- Temperature on the display is measured in degrees Fahrenheit.
- Remember to launch the shuttle; the temperature cannot be warmer than 99 degrees F for more than 30 minutes or less than 48 degrees F.

SHUTTLE TEMPERATURE RULES

Ambient Air Temp, Deg F

Wind Speed (Kts)	48	47	46	45	44	43	42	41	40	39	38	37	36
0 to 1	≥ 0	≥ 65	≥ 75	≥ 80	≥ 90								
2		≥ 0	≥ 65	≥ 75	≥ 80	≥ 90							
3								≥ 0	≥ 80	≥ 90			
4										≥ 0	≥ 90		
5-7											≥ 0		
8-14												≥ 0	
≥ 15													≥ 0

VALUES IN TABLE ARE RELATIVE HUMIDITY IN %

Key:

- **Green - i.e., no violation**
- **Conditional - i.e., Green or Red depending upon relative humidity**
- **Red - i.e., violation of minimum air temp criteria**

ALSO: Propellant Loading shall not be initiated if

- **Average temp for the 24 hours prior to tanking is < 41.3F**
- **Temp any time during past 24 hours < 33F**

Weather Technician for Temperature using the Digital Display

Big Question: Will the temperature meet the Launch Commit Criteria for the shuttle launch?

As the Weather Technician for the monitoring temperature using the Digital Display you are in charge of monitoring the temperature at the launch pad and predicting whether the launch is a go or no go based on the wind speed and direction.

Pre-Launch Work

- Study the Digital Display, locating the temperature and sky conditions on the display.
- Practice using your Temperature Data Sheet before the launch so you will be confident at launch countdown in your job.

Launch Tasks: Radar Precipitation: Temperature: Fill in the weather data on the data-recording sheet from the Digital Weather Display. Write the temperature in the correct column. Write yes or no if the weather conditions are within the weather launch commit criteria. Share your information with the meteorologist to determine whether the weather conditions will **permit**, **delay,** or **scrub** the launch.

- Identify the temperature condition(s) that cause a delay or warning that could delay or stop the launch.
- Identify the weather condition(s) that could delay or stop the launch.
- Monitor the temperature and sky conditions.
- Determine if the temperature isless than 99^0 F and greater than 48^0 F for the final 20 minutes of the launch countdown.
- Accurately record the data on your launch sheet for each minute in the 20 minute launch countdown. You must make sure that there are yeses in all of the columns to permit the launch.

BAROMETRIC PRESSURE

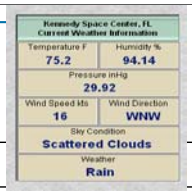
Barometric Pressure

- Pressure refers to the “weight” of the air pressing down on the Earth, the ocean and on the air below.
- Earth's gravity is the downward force that we call "weight."
- Air pressure becomes less the higher you go in the atmosphere, because there is less air to “weigh” you down.
- Air pressure is *one of the most important factors that determine the weather*.
- Air pressure changes with the weather.
- High pressure is usually associated with good weather and
- Low pressure is usually associated with rain and storms.

Barometric Pressure, Wind Speed and Direction

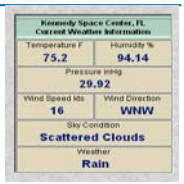
- The National Weather Service provided information in the following table for a prediction of weather based on wind and barometric pressure.
- Study it carefully to understand how pressure, wind speed, and direction interact to create weather.

WIND, BAROMETRIC PRESSURE, PRESSURE TRENDS AND WEATHER



Wind Direction	Barometric Pressure Reading	Barometric Pressure Trend	Weather
SW to NW,	30.10 to 30.20	and steady	Fair with slight temperature change for 1 to 2 days.
SW to NW,	30.10 to 30.20	and rising rapidly	Fair, followed within 2 days by rain.
SW to NW	30.20 and above	and stationary	Continued fair, with no decided temperature change
SW to NW	30.20 and above	and falling slowly	Slowly rising temperature and fair for 2 days
S to SE	30.10 to 30.20	and falling slowly	Rain within 24 hours.
S to SE	30.10 to 30.20	and falling rapidly	Wind increasing in force, with rain within 12 to 24 hours
S to E	29.80 or below	and falling rapidly	Severe storm imminent, followed within 24 hours, by clearing, and in winter by colder
SE to NE	30.10 to 30.20	and falling slowly	Rain in 12 to 18 hours
SE to NE	30.10 to 30.20	and falling rapidly	Increasing wind, and rain within 12 hours
SE to NE	30.00 or below	and falling slowly	Rain will continue 1 to 2 days
SE to NE	30.00 or below	and falling rapidly	Rain, with high wind, followed, within 36 hours by clearing, and in winter by colder
E to NE	30.10 and above	and falling slowly	In summer, with light winds, rain may not fall for several days
E to NE	30.10 and above	and falling slowly	In winter, rain within 24 hours
E to NE	30.10 and above	and falling rapidly	In summer, rain probably within 12 to 24 hours
E to NE	30.10 and above	and falling rapidly	In winter, rain or snow, with increasing winds, will often set in when the barometer begins to fall and the wind sets in from the NE.
E to N	29.80 or below	and falling rapidly	Severe northeast gale and heavy precipitation; in winter, heavy snow, followed by a cold wave.
S to SW	30.00 or below	and rising slowly	Clearing within a few hours and fair for several days.
Going to W	29.80 or below	and rising rapidly	Clearing and colder

METEOROLOGIST FOR PRESSURE TRENDS USING THE DIGITAL DISPLAY



Big Question: Is the barometric pressure rising or falling?

As the meteorologist for the monitoring pressure trends using the Digital Display you are in charge of monitoring pressure trends at the launch pad and predicting whether the launch is a go or no go based on the pressure trends.

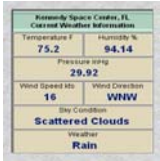
Pre-Launch Work

- Study the Digital Display, locating pressure in Hg on the display.
- Practice using your Pressure Trends data sheet before the launch so you will be confident at launch countdown in your job.

Launch Tasks: **Pressure Trends: When barometric pressure falls rapidly storms are on the way**! Fill in the weather data on the data recording sheet from the **Digital Display**. Use the table to predict the weather conditions for the launch. Weather conditions in **bold print** may delay the launch. Share your information with the meteorologist to determine whether the weather conditions will **permit**, **delay**, or **scrub** the launch

- Use the Wind and Pressure Weather Table to Identify the pressure trends that cause a delay or warning that could delay or stop the launch.
- Identify the weather condition that could delay or stop the launch.
- Monitor the pressure trends.
- Determine if the pressure is rising and falling either slowly or rapidly.
- Accurately record the data on your launch sheet for each minute in the 20 minute launch countdown. You must make sure that there are yeses in all of the columns to permit the launch.

METEOROLOGIST FOR BAROMETRIC PRESSURE WITH WIND SPEED AND DIRECTION USING THE DIGITAL DISPLAY



Big Question: Do wind speed and direction and barometric pressure help predict weather conditions?

As the meteorologist for the monitoring barometric pressure with wind speed and direction using the Digital Display you are in charge of monitoring the interaction of pressure and winds at the launch pad and predicting whether the launch is a go or no go based on the pressure trends.

Pre-Launch Work

- Study the Digital Display, locating pressure in Hg, wind speed, and direction on the display.
- Practice using your Weather Wind and Pressure data sheet before the launch so you will be confident at launch countdown in your job.

Launch Tasks: Weather Wind and Pressure: Fill in the weather data on the data recording sheet from the Digital Weather Display. Use the table to predict the weather conditions for the launch. Weather conditions in **bold print** may delay the launch. Share your information with the meteorologist to determine whether the weather conditions will **permit**, **delay**, or **scrub** the launch

- Use the Wind and Pressure Weather Table to Identify the wind speed, wind direction, and pressure that cause a delay or warning that could delay or stop the launch.
- Identify the weather condition that could delay or stop the launch.
- Monitor the wind speed, wind direction, and pressure .
- Accurately record the data on your launch sheet for each minute in the 20 minute launch countdown. You must make sure that there are yeses in all of the columns to permit the launch.

USER LAUNCH WIND CONSTRAINT

DO NOT launch if peak winds exceed wind criteria (60')

- Peak Wind Speed range: wind is >36 mph, depending upon direction

Wind Dir (deg)	Wind Spd (Kts)
000 - 001	
002 - 004	
005 - 009	
010 - 016	
017 - 043	36 MPH
044 - 050	
051 - 055	
056 - 058	
059 - 062	23
063 - 064	24
065 - 067	25
068 - 069	26
070 - 071	27
072 - 073	28
074	29
075 - 076	30
077	31
078	32
079	33
080 - 100	34
101 - 110	31
111 - 120	30
121 - 134	29

Wind Dir (deg)	Wind Spd (Kts)
135 - 140	28
141 - 152	27
153 - 157	26
158 - 163	25
164 - 196	24
197 - 202	25
203 - 223	26
224 - 229	27
230 - 233	28
234 - 236	29
237 - 239	30
240 - 241	31
242 - 244	32
245 - 340	34
341	33
342	32
343	31
344 - 345	30
346	29
347 - 348	28
349 - 350	27
351 - 352	26
353 - 355	25
356 - 357	24
358 - 359	23

Weather Officer for Wind Speed using the Digital Display

Big Question: Based on the wind speed will the wind be within launch constraints?

As the Weather officer for the monitoring the wind speed using the Digital Display you are in charge of monitoring the wind speed at the launch pad and predicting whether the launch is a go or no go based on the wind speed.

Pre-Launch Work

- Study the Digital Display, locating the wind speed on the display. **Notice that the wind speed is in kts and you will want to report it in miles per hour to the launch commander.**
- Practice using your Wind Speed data sheet before the launch so you will be confident at launch countdown in your job.

Launch Tasks: **Wind Speed Conversion:** Fill in the weather data on the data-recording sheet from the Digital Weather Display. Write the wind direction then the wind speed in knots. Next, convert the wind speed to miles-per-hour (mph). Share your information with the meteorologist to determine whether the weather conditions will permit, delay, or scrub the launch.

- Identify the temperature conditions that cause a delay or warning that could delay or stop the launch.
- Identify the wind speed conditions that could delay or stop the launch.
- Monitor the wind speed in kts and convert it to mph.
- Determine if the wind speed is greater than or less than 36^0 F for the final 20 minutes of the launch countdown.
- Accurately record the data on your launch sheet for each minute in the 20 minute launch countdown. You must make sure that there are yeses in all of the columns to permit the launch.

HUMIDITY AND PRECIPITATION

Humidity

- is the amount of water vapor in the air.
- does not have to be 100% for it to be raining.
- does have to be 100% where the clouds are forming and in the clouds that the rain is coming from.
- The higher the humidity the more likely it is to have clouds in the sky and rain.

SHUTTLE PRECIP RULE

DO NOT launch if precipitation (visible rain, virga, or minimum discernible weather radar echo) exists in the flight path.

Weather Technician for Rain on the Launch Pad using the Digital Display

Big Question: Is it raining on the launch pad or in the flight path?

As the Weather Technician for the monitoring rain on the launch pad or in the flight path using the Digital Display you are in charge of monitoring precipitation at the launch pad and predicting whether the launch is a go or no go based on precipitation.

Pre-Launch Work

- Study the Digital Display, locating the humidity, pressure, sky conditions and weather on the display. Practice using your Precipitation data sheet before the launch so you will be confident at launch countdown in your job.

Launch Tasks: **Precipitation - Digital Display:** Fill in the weather data on the data-recording sheet from the Digital Weather Display. **To launch there can be no precipitation at the launch pad or within the flight path.** Write **yes** or **no** to determine if the weather conditions are within the weather launch commit criteria. Share your information with the meteorologist to determine whether the weather conditions will **permit**, **delay**, or **scrub** the launch.

- Identify the weather conditions that could delay or stop the launch.
- Identify the humidity, pressure, sky conditions and weather that cause a delay or warning that could delay or stop the launch.
- Monitor the humidity, pressure, sky conditions and weather to determine if the precipitation is within Launch Commit ranges .
- Accurately record the data on your launch sheet for each minute in the 20 minute launch countdown. You must make sure that there are yeses in all of the columns to permit the launch.

QUESTIONS? QUESTIONS?

Launch view from Tampa

LAUNCH!

Let’s launch the shuttle!!!

Here are the important terms we learned today. What does each acronym stand for? <note: with each click, a new term will slide in>

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