Responses to Comments on DG-1247

Draft regulatory guide DG-1247, and two technical references to it, NUREG/CR-7004 and NUREG/CR-7005, were issued for public comment. Two public comments were received. A third comment generated internal to the NRC was also considered. This document contains the staff's understanding of the three comments and the staff's responses to them.

References:

1. Comment #1: CASE Comment on DG-1247 NRC ADAMS reference number ML102980163

   Comment (1) of Barry J. White on behalf of Citizens Allied for Safe Energy, Inc., on Draft Regulatory Guide DG-1247, "Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants." Document date: 10/21/2010

2. Comment #2: Bechtel Comment on DG-1247 NRC ADAMS reference number ML103130028

   Comment (2) of Desmond Chan, on Behalf of Bechtel Power Corporation, on Draft Regulatory Guide DG-1247, "Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants". Document date: 11/04/2010

3. Comment #3: Email from Brad Harvey to Selim Sancaktar

4. Draft DG-1247: "Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants".

Comment #1:

POSTION PAPER: Lack of Scientific Evidence That Turkey Point Experienced Category 4 Winds During Hurricane Andrew in 1992

INTRODUCTION

Citizens Allied for Safe Energy, Inc./CASE is a Florida non-profit corporation which advocates safe, renewable, sustainable energy sources and distributed energy production in South Florida. CASE has no paid staff; all work is done by active members, advisors and expert witnesses on a volunteer basis.

In response to the referenced request by the Nuclear Regulatory Commission, CASE is very concerned that statements published by the NRC that Turkey Point experienced Category 4 Hurricane winds during Hurricane Andrew in 1992 are not supported by facts. Published research by NOAA scientists indicates that winds no greater than Category 3 were experienced and that any conclusions regarding the damage at Turkey Point during that event cannot be attributed to a higher force wind. More recent research only indicates that might have experienced high winds but not with reliable and usable certainty.

Information Notice 93-53 referenced above was, as stated in the notice, prepared by an NRC/Industry team. The report was actually prepared by the Institute of Nuclear Power Operators/INPO.

CONCLUSION

The purpose of this submission to the NRC is not to present an exhaustive scientific analysis of the issues raised by CASE. Rather, it is CASE's intention to call the NRC's attention to the existence of the research referenced and to point out that the conclusions drawn from incorrect data in the published NRC report published in NRC Information Notice 93-53 should be tempered and redefined in accordance with the findings of Dr. Powell and his associates in determining the strength of structures related to energy production in a hurricane zone.

It should be noted that Dr. Powell's email statement on October 19, 2010 makes no conclusive statement. He only says *"indications* that Andrew was indeed and Category 5 storm." And ... " it is likely that Cat 5 winds were experienced at that location." (emphasis added). These guarded statements hardly constitute a statistically significant basis for meaningful conclusions. And the earlier studies and information reported in Parts 1 and 2 of Drs. Powell and Houston's work.

One can only conclude: *There is no scientific evidence that Turkey Point experienced greater than moderate Category 3 winds during Hurricane Andrew. Therefore, NRC INFORMA TION NOTICE 93-53 cannot be used to demonstrate otherwise.*

Response to Comment #1:

This comment refers to the NRC information notice 93-53 about Hurricane Andrew in 1992 and its conclusion is also about the same information notice. The comment states that the statement in the information notice about the Turkey Point site experiencing category 4 hurricane winds is not supported by facts; the conclusion states that the site most likely experienced category 3 hurricane winds.

Characteristics of the past hurricanes were used as data to create simulation models and address uncertainties. No single past data point is expected to influence models to a significant degree. The staff examined draft NUREG/CR-7005 and the draft regulatory guide DG-1247 for references to hurricane Andrew and Turkey Point and found no direct reference. This comment appears to be not related directly to the documents asked to be reviewed and commented on. Thus the staff does not see any action to be taken on the documents to be reviewed.

As a side point, even if this event were used for estimating maximum winds, and even if it were actually category 3 but was used as category 4, at most, the effect would have been conservative in estimating the maximum wind speeds. Overestimating the strength of historical hurricanes (such as classifying Hurricane Andrew as a category 4 instead of a category 3 storm) biases the historical record towards stronger storms, which would result in conservatively predicting higher maximum wind speeds. As for hurricane missiles, historical events were not used in generating missile speeds in NUREG/CR-7004 which supports the draft regulatory guide.

Comment #2:

Comments on Draft Regulatory Guide DG-1247
Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants

Currently, NRC expectation for COLA content includes the applicant's presentation of a historical maximum or the 100-year return values for hurricane velocities at the proposed site, using the more limiting value to characterize the site. Our involvement in these recent COLA preparations has resulted in our examination of a significant portion of the hurricane historical database, and we are concerned that the methodology used to develop DG-1247 has resulted in a significant departure from historical wind speed data and has significantly extended these wind speeds inland, well beyond what has been observed. The following observations are intended to present the level of conservatism that we have observed and to offer possible explanations within the methodology that could have lead to these conservatisms.

1. In the five coastal regions[1] the design-basis gust winds provided in DG-1247 are often more than 30% higher than the HURDAT wind speed values obtained from historically significant hurricanes. Table 1 summarizes the significant storms that were investigated for this study. This set was selected based on damage caused at landfall and damage during the inland progress of the storm. Storm tracks are provided in attached Figures 1a – 1m, and the proposed contours from DG-1247 are superimposed on these figures. Consideration should be given to calibration of the 10^{-7} per year gusts to historical values for land-falling wind speeds.

2. The hurricane database is much smaller than that for tornados. Because a relatively small dataset raises the potential for any extrapolation to compound the uncertainty, of the result, the repeated extrapolations required to generate values for frequencies of 10^{-7} per year from a dataset with a period of record of 10^{2} years risk becoming overly conservative based on the historical record. Further, the impacts of the short period of record may be further amplified by the relative (spatial and temporal) scarcity of data points within the database.

3. Related to items 1 and 2, for land-falling hurricanes in NUREG/CR-7005 (Reference 12) unrealistic translation wind speeds might have been used. For higher probability events, this limitation is not evident (see Figures 2-24 and 2-25 of Reference 12 or Figure 6-1 of Reference 5). At low frequency (10^{-6} or 10^{-7} per year), the wind speed values appear to have unrealistic behavior. Figure 2 shows contours of maximum estimated wind speeds from landfalling Category 3/4/5 hurricanes (Reference 1); these contours exhibit sharper gradients of wind speed than the contours from DG-1247. Using HURDAT data, Table 2 presents maximum landfall 3-second gust wind speed for Category 3 and above hurricanes.

Simplified HURDAT data were examined for Category 4 and 5 storms for storm motion. Storms with more rapid forward movement tend to have direction changes to the east, accelerating forward motion immediately preceding rapid decreases in intensity. These are indicative of hurricane interaction with mid-latitude troughs and weakening. The rapid decrease in intensity of these observed storms suggests that while some storms can be observed to have this high forward speed, this subset would be weakening prior to landfall, and the subsequent loss of inflow after landfall would decrease the overall intensity faster than the DG-1247 model predicts. In general, it has been concluded that hurricane wind speeds in flat terrain decrease by about 15% in the first 15 km from the coast (Reference 14).

This argument suggests that the entire range of possible hurricane translation speeds should not be used as inputs to creating the maximum wind speeds. Entrainment of dry air and loss of inflow for land-falling storms is such that strong storms cannot persist to transfer the high winds as far inland as DG-1247 suggests. These effects do not appear to be discreetly accounted for in the methodology described in NUREG/CR-7005 (Reference 12).

Additional Minor Comments

* There are 2 typographical errors on pages 28 and 30 (one each) of NUREG/CR-7005, where the unit conversion for the wind speed bin width (5 mph) is incorrectly presented. It should be 2.23 ms^{-1} (or 2.2 ms^{-1} if being generalized), not 2.5 and 4.5 ms^{-1}, respectively.

* Suggest providing state boundaries in Figures 1 through 3 of DG-1247, because storm data can be conveniently sorted by state from the NCDC NOAA storm events database. It is difficult to see state boundaries among the many county boundaries, unless some method of contrast is introduced.

[1] Texas, Louisiana/Mississippi, Florida, Southeastern Atlantic, and New England.

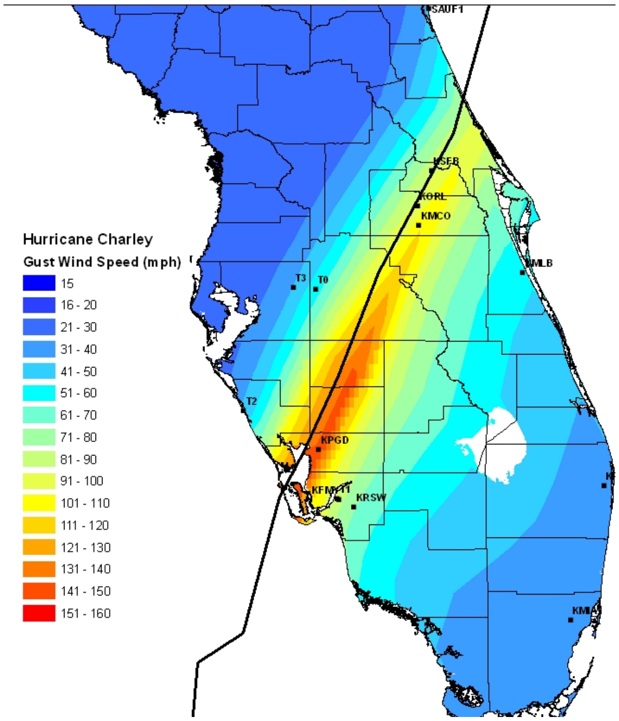
Response to Comment #2:

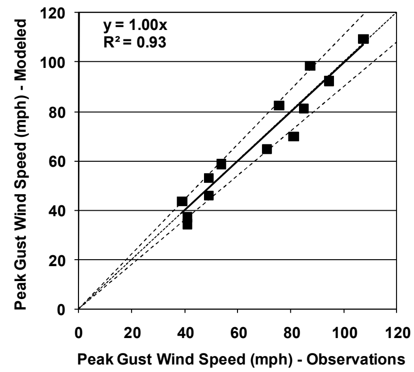
Comment within the introductory paragraph. "Currently, NRC expectation for COLA content includes the applicant's presentation of a historical maximum or the 100-year return values for hurricane velocities at the proposed site, using the more limiting value to characterize the site."

Response: *There have generally been two wind load design points for new reactors: (1) an operating basis wind (OBW) load and (2) a design basis tornado (DBT) load. The OBW load is a severe environmental load that could infrequently be encountered during the plant life and has been defined (per SRP 2.3.1) as the 100-yr return period wind load. The DBT load is an extreme environmental load that is credible but highly improbable and has been defined (per RG 1.76) as a tornado having a mean frequency of* 10^{-7} *per year. The OBW load is analyzed using a combination of different load factors and load combinations* as compared to *the DBT load. The introduction of DG-1247 does not change the basis for the OBW load. Instead, the introduction of DG-1247 is intended to redefine the extreme environmental load. The extreme environmental load will now be either the RG 1.76 DBT load or the DG-1247 design-basis hurricane load, whichever is bounding for the site being evaluated.*

Comment within the introductory paragraph. "…the methodology has resulted in a significant departure from historical wind speed data and has significantly extended these wind speeds inland."

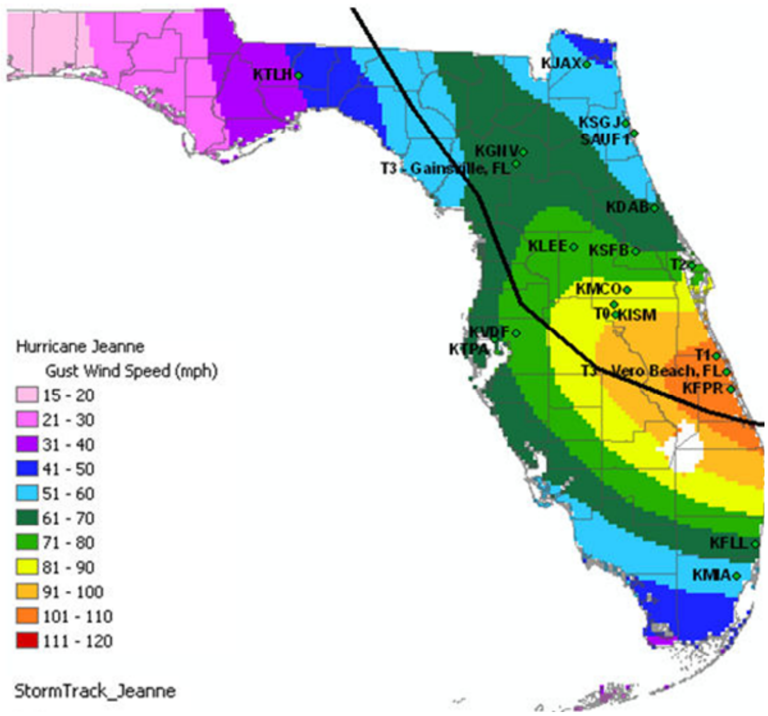
Response: *The wind field model has been validated using historical wind speed data as described in numerous papers and reports (e.g. Vickery et al., 2000, Vickery et al., 2009a). Those comparisons indicate that the model performs well both at the coast and inland. Many of these comparisons were presented in the Technical Basis document NUREG/CR-7005, as well as in Vickery et al. (2009a). The inland wind speeds are based upon the well validated wind field model that properly treats the sea-land transition and the growth of the hurricane boundary layer as the storm progresses inland. This wind model is coupled with a filling model (increase in central pressure as the storm moves inland) which is described in detail in Vickery (2005). The filling model weakens hurricanes fastest in the case of small, intense, fast moving hurricanes, such as Hurricane Charley. Figures 1 and 2 present model gust wind swaths for the 2004 Hurricanes Charley and Jeanne in Florida. Notice the inland extension of the strong winds associated with both hurricanes. The marine winds (which are 10% to 15% higher than the open terrain winds) are not shown in these Figures. Also note the good agreement between modeled and observed winds at both near coast and inland locations.*

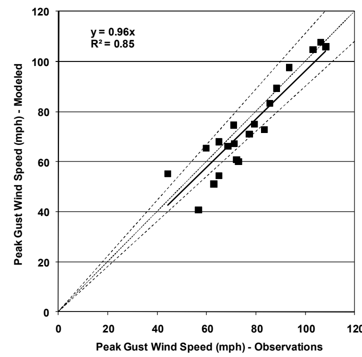




ASOS	Description	Peak Gust Speed (mph)	
		Obs	Model
KFMY	Fort Myers International Airport	85	81
KMCO	Orlando International Airport	107	109
KSFB	Orlando Sanford International Airport	94	92
KORL	Orlando Executive International Airport	87	98
KMIA	Miami International Airport	41	34
KMLB	Melbourne Regional Airport	49	53
KPBI	Palm Beach International Airport	41	37
KRSW	Ft Myers Regional Airport	81	70
FCMP T0	FCMP Tower 0	54	59
FCMP T1	FCMP Tower 1	76	82
FCMP T2	FCMP Tower 2	49	46
FCMP T3	FCMP Tower 3	39	43
SAUF1	St Augustine C-MAN Platform	71	65

Figure 1. Comparison of modeled and observed peak gust wind speeds for Hurricane Charley showing the inland extent of strong winds. Note the high winds in Orlando (KMCO) which is 200 km inland from the landfall location. Dashed lines shown in the scatter plot indicate ±10%.





ASOS	Description	Peak Gust Speed (mph)	
		Observed	Modeled
KDAB	Daytona Beach ASOS	72	61
KFLL	Fort Lauderdale ASOS	60	65
KFPR	Fort Pierce ASOS	108	106
KGNV	Gainesville ASOS	71	67
KJAX	Jacksonville ASOS	63	51
KLEE	Leesburg ASOS	79	75
KMCO	Orlando International Airport ASOS	85	83
KMLB	Melbourne ASOS		95
KPBI	Palm Beach Airport ASOS		91
KSFB	Orlando-Sanford International Airport ASOS	77	71
KTPA	Tampa International Airport ASOS	65	68
KVDF	Tampa Vandenburg ASOS	83	73
LKWF1	Lake Worth C-MAN Station	93	98
T0	FCMP Tower T0	88	89
T1	FCMP Tower T1	103	105
T2	FCMP Tower T2	71	75
T3	FCMP Tower T3	106	108
T3	FCMP Tower T3 - Gainsville	69	66
SAUF1	St Augustine C-MAN	73	60
KMIA	Miami International Airport ASOS	44	55
KSGJ	St. Augustine Airport ASOS	65	54
KTLH	Tallahassee Regional Airport	57	41

Figure 2. Comparison of modeled and observed peak gust wind speeds for Hurricane Jeanne showing the inland extent of strong winds. Dashed lines shown in the scatter plot indicate ±10%.

Comment 1. In the five coastal regions the design-basis gust winds provided in DG-1247 are often more than 30% higher than the HURDAT wind speed values obtained from historically significant hurricanes. Table 1 summarizes the significant storms that were investigated for this study. This set was selected based on damage caused at landfall and damage during the inland progress of the storm. Storm tracks are provided in attached Figures 1a – 1m, and the proposed contours from DG-1247 are superimposed on these figures. Consideration should be given to calibration of the 10^{-7} per year gusts to historical values for land-falling wind speeds.

Response: *Bechtel's Table 1 compares historical storm wind maxima to modeled wind speeds predicted to occur at annual rates of 10^{-6} and 10^{-7} (return periods of one million and ten million years, respectively.) However the historical storms listed have all occurred in the past 60 years. One would expect a 10^{-6} wind speed to be notably higher than the observed wind speeds obtained over the past 60 years.*

Below, the response is discussed in terms of i) Regional Analysis, and ii) Point Analysis.

i) Regional Analysis *A more reasonable comparison using the data given in Bechtel's Table 1 is to show ARA's predicted hurricane hazard curve along with an empirically based hazard curve developed using the Bechtel data (from their Table 1) that applies to a large region, the size of the coastal United States. This comparison is shown in Figure 3. The hazard curve* *generated from the simulated hurricanes represents a hazard curve for any point, anywhere in the entire United States. (i.e., the curve reflects the average return period expiring, or exceeding, the indicated wind speed anywhere (on land) in the continental United States, rather than at a point). The hazard curve was derived by retaining only the maximum wind speed from each simulated hurricane, irrespective of the location of the maximum wind speed.*

The empirical hazard curve obtained from the Bechtel data was developed using a similar approach, where we rank ordered the gust wind speeds given in Table 1. (If two wind speeds appear in the gust wind speed column in Table 1, we used the values labeled H). A CDF was then computed from the rank ordered data and used in a Poisson based risk model (with the annual occurrence rate defined as the total number of wind speeds (19) divided by the total number of years (57)), to develop a wind speed hazard curve. Two empirically based curves were developed, one for the case where the wind speeds given in Table 1 were used without modification, and the other developed assuming the wind speeds given in Table 1 are marine values, and so we convert them to land based values by reducing the gusts by 15%. This 15% value is suggested by Bechtel, but it overstates the true reduction in the peak gust wind speed as the wind moves from a marine terrain to an open terrain, which varies between 10% and 15%, but is closer to the 10% value.

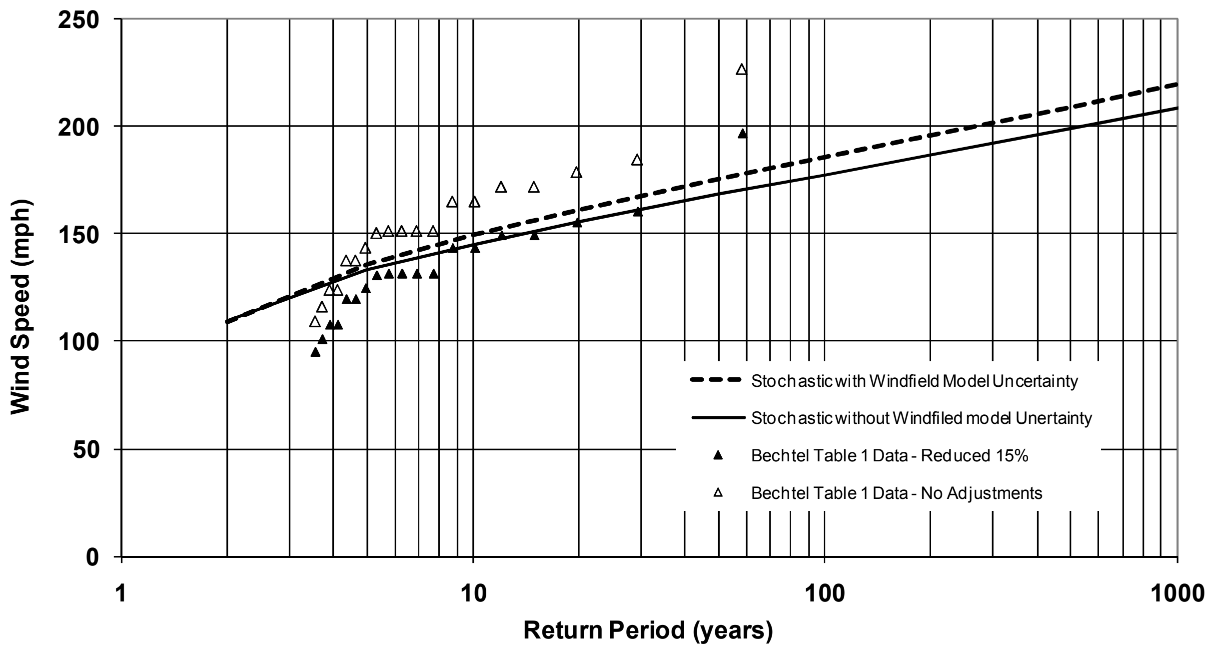


Figure 3. Comparison of wind speed hazard curves from the stochastic model and an empirical hazard curve derived using the data from Table 1 provided in the Bechtel comment document. Hazard curves represent the return period associated with the maximum wind speed recorded anywhere in the United States. Stochastic results are given with and without wind field model uncertainty. Empirical hazard curves represent upper and lower bounds values assuming input (upper bound) winds are given for marine terrain and the lower bound winds are given for fully transitioned open terrain winds.

In the case of the stochastic wind speeds, since information on the exact model grid point location of the storm-by-storm maximum obtained from the model is not known, but we do know that the distance from the coast of the grid points that likely experienced the maximum wind range from about a hundred meters to a kilometer or so. Therefore these winds will not have been fully transitioned from marine conditions to open terrain conditions, thus we expect the two sets of Bechtel winds to bracket the stochastic model wind speeds (assuming the Bechtel wind speeds are reasonable estimates of the true storm maxima).

The comparison in of the Bechtel winds and the model winds in a rationale manner as seen in Figure 1 indicates that the return periods associated with the model winds agree with, or are higher (indicating that the model yields approximately equal or lower winds for the same return period) than those derived from the wind data provided by Bechtel.

A curve similar to that given in Figure 3 is given again in Figure 4. Figure 4 is adapted from Vickery et al (2009a). As in Figure 3, the wind speeds given in Figure 4 are representative of a hazard curve that reflects the maximum wind speed anywhere in the US as a function of return period (i.e. an area hazard curve rather than a point hazard curve).

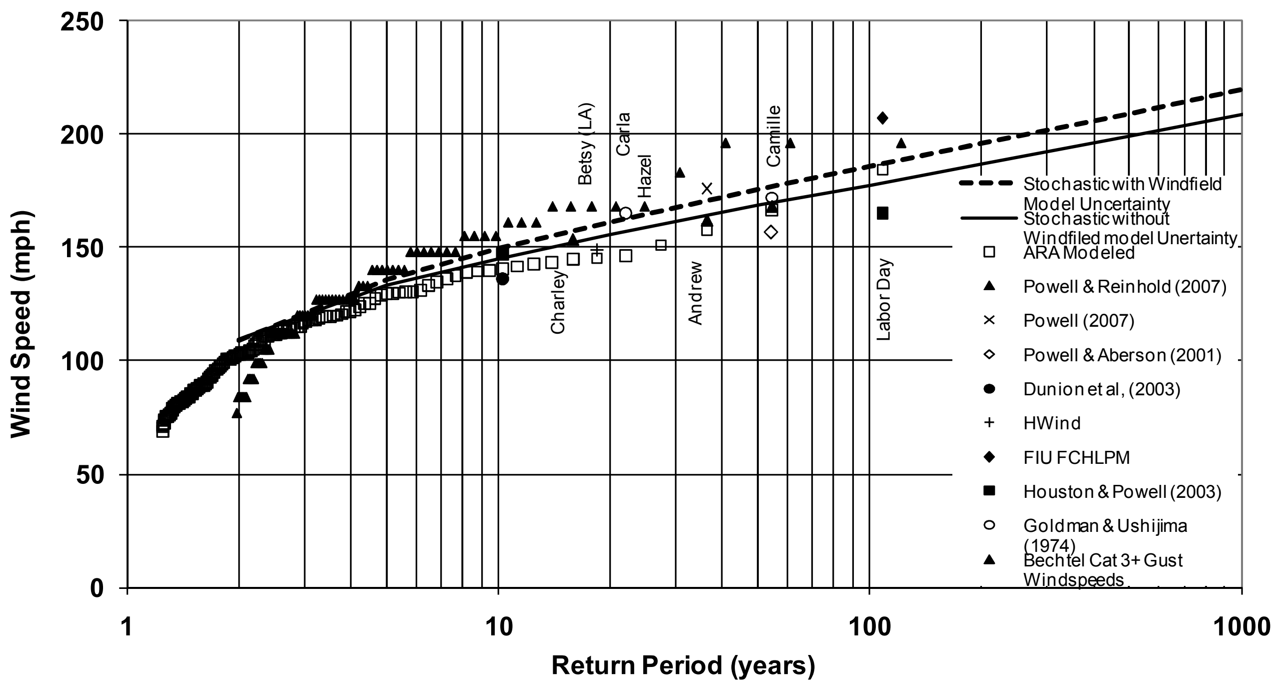


Figure 4. Comparison of hurricane hazard curves derived from the stochastic model (with and without wind field model uncertainties to emprtical hazard curve derived using the estimated maximum open terrain gust wind speeds produced by each historical hurricane. (Adapted from Vickery et al, 2009a). Wind speeds from Table 2 from the Bechtel comments are also presented. The Table 2 wind speeds are presented with no modification from the data given in Table 2 of the Bechtel comments.

The empirical wind speed hazard curve shown in Figure 4 was developed using a combination of model hindcast wind fields, and estimates of maximum wind speeds reported in the engineering and meteorological literature. These storm-by-storm winds represent the maximum wind speed on land produced by the hurricane in question. The results presented in Figure 4 indicate good comparisons of modeled and observed wind speeds when presented as a function of return period. Also shown in Figure 4 is the empirical wind speed hazard curve derived using the maximum gust wind speeds provided by Bechtel in their Table 2. The Table 2 wind speed data suggest that the simulation model actually underestimates the US area wide hurricane wind hazard

In the model development process we ensure that the model reproduces the distributions of storm central pressure at the time of landfall. These validation comparisons include all hurricanes making landfall in the United States between 1900 and the present. A direct calibration with measured gusts at any given location is extremely difficult as most wind speed measurement systems used in the US to record wind speeds fail, in high wind conditions before the maximum wind speed is record (failure is usually due to lost power and the ability to record the data rather than failure of the anemometer itself). For example, the maximum wind speed was not recorded in Hurricanes Camille (1969), Andrew (1992), Charley (2004) or Katrina (2005).

***ii) Point Analysis.** In a separate study, we performed comparisons of wind speeds vs. return period derived from the stochastic storm set to an empirical hazard curve developed from a hybrid of modeled site specific wind speeds and measured wind speeds for two point locations in the New Orleans area (KMSY and KNEW). Where possible measured data are used in the plots shown in Figure 5, otherwise the gust wind speed data represent the best estimate of the wind speed at the site estimated through a model hindcast of the historical hurricane. The results indicate that the hazard curve developed using the stochastic storm set agrees well with the empirically derived hazard curve.*

Response Summary:

The area wide and single point comparisons of modeled and historical wind speeds presented here indicates that the model does not have a high bias in terms of the predicted wind speeds. The comparisons we have made here include examples we have developed in the past, as well as by using the wind data provided by Bechtel.

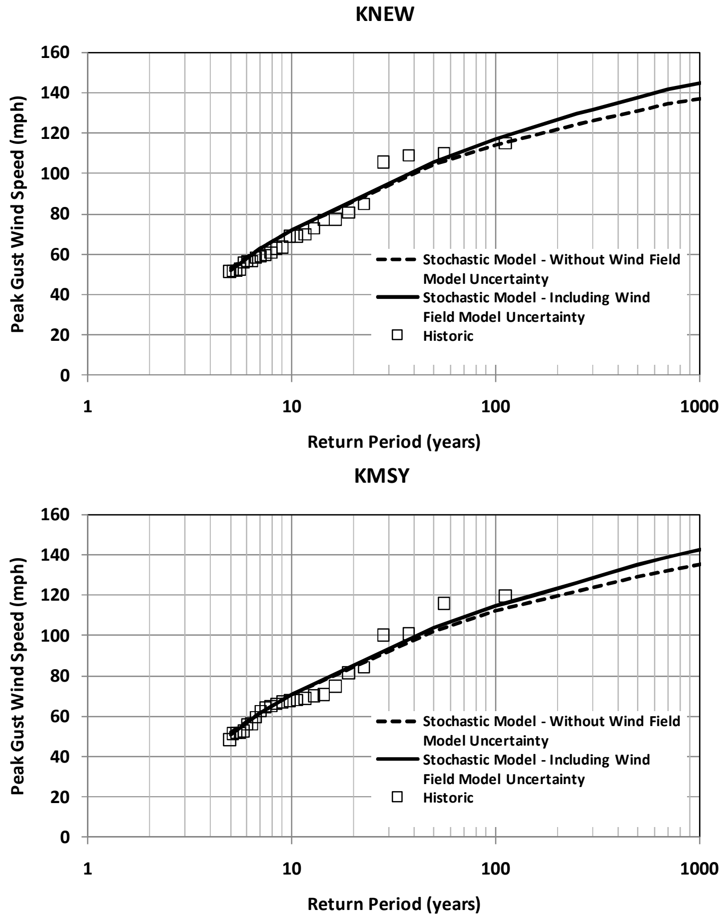


Figure 5. Comparisons of stochastic and empirically derived wind hazard curves for the New Orleans area.

Comment 2. The hurricane database is much smaller than that for tornados. Because a relatively small dataset raises the potential for any extrapolation to compound the uncertainty of the result, the repeated extrapolations required to generate values for frequencies of 10^{-7} per year from a dataset with a period of record of 10^2 years risk becoming overly conservative based on the historical record. Further, the impacts of the short period of record may be further amplified by the relative (spatial and temporal) scarcity of data points within the database.

Response: *First, the scope and content of the hurricane and tornado databases are very different. Although the hurricane database does have fewer individual event records than the tornado database, the basis for the recorded wind speed in each database is different. While hurricane wind data is generally based on direct measurement, tornado wind speeds require a more subjective process to determine wind speed based on the Fujita (F) or Enhanced Fujita (EF) assignment for each event. Additionally, a hurricane event is associated with a much larger area of land compared to a tornado event. Therefore, it is incorrect to conclude that the historical record for hurricane events is inherently more uncertain than the tornado record due to relative differences in the number of recorded events.*

Second, the draft NUREG/CR-7005 explains in detail the modeling methodology and indicates that the distribution of landfall pressures, over varying sized coastal segments match the historical data very well. The draft NUREG/CR-7005 also indicates that the modeled pressures are limited to have a relative intensity of 1.0 to avoid unrealistic values of central pressure. The dataset is not extrapolated, but rather is used to ensure that the model reproduces statistical distribution of central pressure at the time of landfall, translation speed, storm heading, and occurrence rate. These comparisons are performed on both small coastal segments, having lengths of the order of 200 to 300 km, as larger coastal segments associated with the coastline of an entire state, or multiple states in the case of States with small coastlines, as well as for very large regions such as the Gulf of Mexico coastline (excluding Florida), the Florida coastline, the Atlantic Coastline (excluding Florida) and the entire US coastline. These comparisons are described in detail in Vickery et al. (2009b) and demonstrate that the model distributions of the various parameters, particularly, central pressure, match the historical record for all size regions. The comparisons also show that the hazard curves become less steep as the return period increases (annual exceedance probability decreases), indicating a realistic behavior in the model as the central pressures are limited because of the relative intensity limit.

Comment 3. Related to items 1 and 2, for land-falling hurricanes in NUREG/CR-7005 (Reference 12) unrealistic translation wind speeds might have been used. For higher probability events, this limitation is not evident (see Figures 2-24 and 2-25 of Reference 12 or Figure 6-1 of Reference 5). At low frequency (10^{-6} or 10^{-7} per year), the wind speed values appear to have unrealistic behavior. Figure 2 shows contours of maximum estimated wind speeds from landfalling Category 3/4/5 hurricanes (Reference 1); these contours exhibit sharper gradients of wind speed than the contours from DG-1247. Using HURDAT data, Table 2 presents maximum landfall 3-second gust wind speed for Category 3 and above hurricanes.

Response: *In the case of translation speed, we have limited the maximum translation speed to be less than or equal to 35 m/sec. In addition, the model limits the effective translation speed used in the wind field model as described in the paragraph below, taken directly from draft NUREGCR-7005. The paragraph discusses the rationale behind using a reduced translation speed in the wind field model for fast moving hurricanes*

A qualitative comparison of the estimated maximum wind speeds of the 1938 New York hurricane (Myers and Jordan, 1956) suggests that the version of the wind field model that uses the full translation speed of very fast moving storms overestimates the maximum wind speeds by about 10 percent. The 1938 hurricane was moving north at a speed of about 20 m/s at the time it crossed the coast of Long Island. To reduce the overestimation of the translation speed effect on rapidly moving hurricanes, this analysis uses a reduced translation speed such that an effective translation speed c_{eff} is defined by

$$c_{\text{eff}} = c, \qquad c < 15 \text{ m/s}$$

$$c_{\text{eff}} = 15 + \frac{c-15}{3}, \qquad 15 < c < 30 \text{ m/s}$$

$$c_{\text{eff}} = 20, \qquad c > 30 \text{ m/s}$$

where c is the original translation speed. This approach to incorporating the translation speed into the wind field model ensures that unrealistic translation speed effects cannot occur in the model.

There are two additional responses addressing the contents of the two paragraphs from the Bechtel document, which are quoted below.

Comment within the fifth paragraph. *Contents of the following Bechtel paragraph are treated as a comment and a response is provided below:*

"Simplified HURDAT data were examined for Category 4 and 5 storms for storm motion. Storms with more rapid forward movement tend to have direction changes to the east, accelerating forward motion immediately preceding rapid decreases in intensity. These are indicative of hurricane interaction with mid-latitude troughs and weakening. The rapid decrease in intensity of these observed storms suggests that while some storms can be observed to have this high forward speed, this subset would be weakening prior to landfall, and the subsequent loss of inflow after landfall would decrease the overall intensity faster than the DG-1247 model predicts. In general, it has been concluded that hurricane wind speeds in flat terrain decrease by about 15% in the first 15 km from the coast (Reference 14)."

Response: *The distributions of central pressure at landfall produced by the stochastic model match the distributions of landfall pressures derived from the historical data along all coastal regions of the United States, including the Northeast. The model pressures include any effects of storm weakening. The model reproduces translation speed-heading correlations where storms that have re-curved towards the north travel faster than westward moving storms. The intensity model used in the stochastic simulation model was developed considering eastward and westward moving storms separately, and thus the impact of heading on intensity is included in the model.*

Furthermore, the model does include a reduction in peak gust wind speed moving from sea to land. This reduction is in the range of 10% to 15%, varying primarily with storm size, and is evident in Figure 6 (discussed below).

Comment within the sixth paragraph. *Contents of the following Bechtel paragraph are treated as a comment and a response is provided below:*

"This argument suggests that the entire range of possible hurricane translation speeds should not be used as inputs to creating the maximum wind speeds. Entrainment of dry air and loss of inflow for land-falling storms is such that strong storms cannot persist to transfer the high winds as far inland as DG-1247 suggests. These effects do not appear to be discreetly accounted for in the methodology described in NUREG/CR-7005 (Reference 12)."

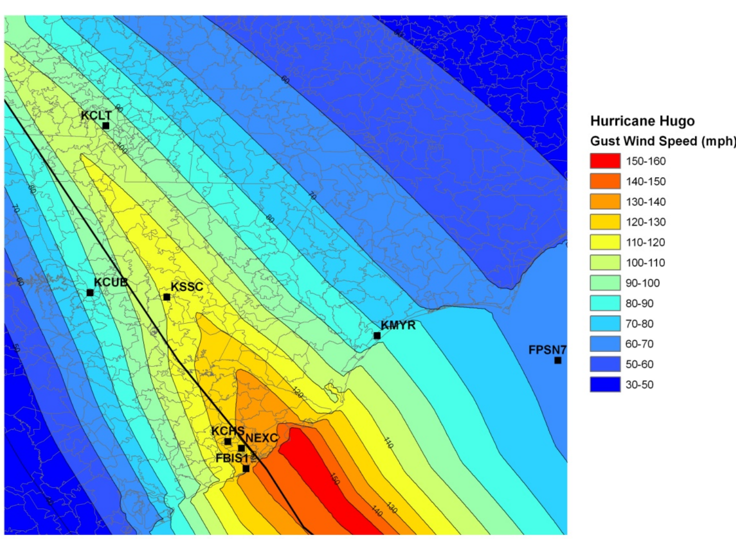
Response: *The hurricane decay models have been developed using actual historical data. The decay models vary with region and we have different models for the Northeast, the Gulf of*

Mexico region, Florida and the Mid-Atlantic coastline. These empirically based filling models inherently include the impact of any local environmental effects including entrainment of dry air, inflow, etc on the increase in the hurricane central pressure after landfall. The development of the filling model is discussed in detail in Vickery (2005).

We also note that strong winds have extended well inland in historical events, including, for example, the 1938 Long Island Hurricane, Hurricane Hazel (1954), Hurricane Hugo (1989) and Hurricane Charley (2004). The modeled wind swath along with measured peak gust wind speeds for Hurricane Charley were shown in Figure 1, and demonstrate the inland extent of strong winds. Figure 6 presents the wind swath for Hurricane Hugo (1989) and the associated measured wind speeds. Finally, quality wind speed measurements have not been available from land based locations prior to about 20 years ago, and even 20 years ago wind speed data from hurricanes at inland locations were few. It is also worth pointing out that at many airport locations in the US the measured winds understate the true open terrain winds due to the effects of upstream terrain. In the analyses performed by ARA, where possible, the measured winds have been adjusted for terrain effects. These local terrain effects are discussed in Masters et al. (2010).

Responses to editorial comments: *The two typos mentioned are corrected. As for the format of the wind maps, the counties are already delineated on the wind maps, and additional tables are provided to allow for potential interpolation for locations not specified. Since the maps have limited size and already contain abundant information, it is deemed appropriate not to crowd more information (such as delineating the state lines) on the wind maps.*

Station	Description	Peak Gust Wind Speed (mph) (mph)	
		Obs	Model
FPSN7	Frying Pan Shoals	71	70
KCLT	Charlotte	91	98
KCUB	Columbia	82	85
NEXC	Charleston Naval Station	116	121
KMYR	Myrtle Beach AFB	87	85
KSSC	Shaw AFB	128	112
KCHS	Charleston AFB/Intl	112	120



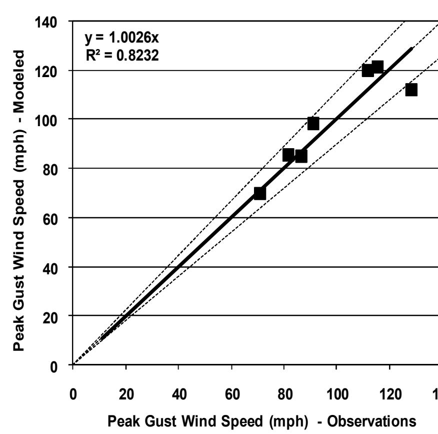


Figure 6. Comparison of modeled and observed peak gust wind speeds for Hurricane Hugo showing the inland extent of strong winds. Note the high winds in Charlotte, NC (KCLT) which is located almost 300 km inland from the landfall location. Dashed lines shown in the scatter plot indicate ±10%.

REFERENCES

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Comment #3:

This technical comment refers to a technical item previously discussed during the NRC internal review.

From: Harvey, Brad
Sent: Wednesday, December 01, 2010 2:06 PM
To: Sancaktar, Selim
Cc: ………..
Subject: RE: Hurricane Reg Guide Comment Resolution

Selim:

I talked to Jerry Chuang (who initiated this comment) and we both prefer if the data in NUREG/CR-7004 regarding the 3.8 kg (8.4 lb) plank missile is replaced with the data for a 9 kg (20 lb) plank missile. Note that DG-1247 will not be affected since the plank missile is not listed in DG-1247.

Response to Comment #3:

The author of the NUREG/CR-7004 will add another missile analysis for a plank 1.0 m x 1.0 m, weighing 20 lbs. to NUREG/CR-7004.

This will not affect the draft regulatory guide DG-1247 since the plank missile is not listed in the guide.