1. For RBI risk base inspection, we go for two methodologies: Qualitative and other quantitative. Kindly explain the limits

On the question about choosing qualitative or quantitative RBI, we need to consider the following strengths and weakness of each methodology.

The Quantitative analysis has some important strengths:

- Reproducible
- Accurate
- Easy to Maintain/ Evergreen
- Easy automation
- Easy sensitivity studies
- Cost effective in the long term

The qualitative analysis may be easier to start with, requires less data and it is easier to communicate outside the RBI team.

So DNV GL recommends a software with multi-level capability. This allows a company with limited RBI experience to start with a qualitative assessment as a first step and then continue with full quantitative analysis, especially for the high-risk items.
2. Can phast/phastrisk calculate risk at low wind speed? (e.g. 1m/s)
   Yes. The current recommended minimum on the latest version of Phast/Safeti is 0.5 m/s.
   Please note that Phast Risk is now known as Safeti.

3. Can QRA be implemented for the nuclear industry?
   A quantitative risk assessment methodology known as “PRA” or “Probabilistic Risk Assessment” is
   used in the Nuclear industry.
   QRA as used in the chemical process and oil and gas industries today was developed from PRA.
   Note that PRA is not the same as QRA. PRA can be described as a more detailed and advanced form
   of QRA.

4. Can you give some recommendations for hardware failure rates and especially human error
   probabilities?
   From experience, human reliability data is a tricky one. Human reliability data is very sparsely
   distributed in the literature and there is no consistent method to capture it.
   The Dutch Red book (Methods for determining and processing probabilities) gives a good discussion
   and examination of human failure probabilities.
   Hardware failure is easier – there are several industry standards available in the market today and
   depending on what you are after, they can be easily accessible. We wrote a blog post that lists most
   of the industry databases available: http://blogs.dnvgl.com/software/2014/09/reliability-
   information-get/
   In general - published literature is the best source for hardware failure rate. Examples include the
   IOGP (International Oil and Gas Producers) Risk Assessment Data Directory (RADD).
5. Do you have any recommendations on mitigation measures of Carbon Monoxide release from Cold Box?
   This is beyond the scope of the webinar content.

6. I know that DNV GL has a software called Synergi where incidences are recorded. Is there any connection between Synergi and MyQRA in terms of using data for decision making on design modification? How is MyQRA is updated?
   You are correct that DNV GL have a tool called Synergi Life that is used for QHSE and enterprise risk management for a vast range of risk types and industries (e.g. Oil and Gas, Healthcare etc.). It is made up of a core application supported by a range of modules for specific risks such as HAZOP module, a BowTie module etc. Read more about Synergi Life [here](#).
   There are currently plans (very early stages) to link Synergi Life to Phast and Safeti to enable consequence and risk analysis within Synergi Life.
   MyQRA is a digital delivery solution for QRA developed by DNV GL. MyQRA would be set up by DNV GL QRA analysts, with the results/models placed on a server and then accessible to clients through a web interface. MyQRA also aims to support sensitivity analysis. Please see [here](#) for more details on MyQRA.
   At the current time, there is no link between Synergi Life and MyQRA - but there is no reason why this link cannot be made in the future.

7. How can I determine a PLL?
   The Potential Loss of Life is calculated by multiplying the population (N – number of people exposed/impacted to/by a risk event) in an area with the risk they are exposed to (f – frequency of a risk event). In QRA terms, PLL is the product of an “f-N” pair for all risk considered.
   Care must be taken in matching the values that are being used, e.g. risk in the form of LSIR will be a per year value. Is the population this is being applied to always there for a full year? Does an average need to be taken? Do changes in personnel distribution through a day need to be accounted for?

8. How can we use QRA to address the need for fire-proofing?
   To use QRA to address the need for fire mitigation (of which fire proofing is one of many possible mitigation options), quantitative fire criteria must be available.
   An example would be, the fire frequency to a vessel, structural member, wall, support etc. that can cause damage/escalation should not exceed a frequency of $10^{-4}$ per year.
   The QRA model could be used to analyse thermal radiation impacts/probabilities from all possible scenarios that can affect the receptor of interest and establish the damage/escalation frequency.
   This output can then be compared with the criteria to assess the need for fire mitigation or otherwise.

9. How do you approach QRA on a unique site/plant where there is limited industry statistics? i.e. when there are no statistics on probabilities of events that directly apply to this particular site/plant?
   There are a couple of options for this scenario:
   1. **Derive statistics on a first principles basis** i.e. using fault tree analysis or other similar methods. Depending on how many failures are being looked at this can be a very cost/time intensive process.
   2. **Use historical data with some modification for the current case.** This would require using a best fit from available historical data. It may be that a modification factor would be applicable,
to increase or decrease the generic figure to better fit the site in question. This would be down to analyst judgement.

3. **A combination of two above.** This can involve using first principle approaches for a limited set of scenarios and then using this information as a basis to tune the historical data.

In all, it is worth remembering with relative applications of QRA, what is of interest is the difference in risk (say, versus a baseline) as opposed to the absolute risk value.

A relative application can be very useful in comparing the risks with multiple unique designs as the risk differential across the designs is more important (e.g. Design A is 100% less risky than Design B) than the actual risk value calculated.

10. **How precise are software in QRA when hydrocarbon, oil, crude oil are considered?**

Most software products will/should provide documentation explaining the models implemented and details of work undertaken to validate (versus experimental data) and verify those models.

Phast, a consequence model tool developed by DNV GL and widely used in the industry has been extensively validated and verified across a whole range of experimental data, materials etc. and shown to provide good predictions of the impact ranges e.g. gas dispersion, fires, explosions etc.

Read [here](#) for a specific example on the validation and verification of Phast for LNG Dispersion modelling in the US.

The full set of validation/verifications are supplied with the software – hence purchasers of Phast have access to this.

Please contact us ([software@dnvgl.com](mailto:software@dnvgl.com)) if you require more validation documentation.

11. **How to do QRA for activity such as mandatory inspection (ILI) on unpiggable pipeline - whether it’s okay not to do it or do with high cost?**

Without more details of the specific case, it is difficult to comment on whether a QRA should be done or not.

If a decision has been made that a QRA is needed (for e.g. to quantify the risk to personnel undertaking the inspection activity), it (i.e. the QRA study) would look to explore and quantify the negative impacts of inspection activity on the unpiggable pipeline, model them if applicable, including estimating the frequency, then compare these effects with the potential problems arising from not carrying out the inspection.

12. **How to estimate IRPA and PLL from software?** We normally use excel spread sheet to calculate these parameters. We use only LSIR value from SAFETI.

PLL is a standard output from Safeti (see the software help files or contact [software.support@dnvgl.com](mailto:software.support@dnvgl.com) if necessary).

On the other hand, IRPA is not a default output from the software. However, IRPA is simply LSIR factored by the time spent in that location so it is relatively straightforward to calculate.

If the LSIR calculated at a location is $1 \times 10^{-4}$ per year, but a worker only spends 50% of their time in that location then their IRPA at that location is $0.5 \times 10^{-4}$ per year (i.e. 50% of the calculated LSIR).
13. Safety valves leaking nearby pipeline and riser, in this case, how QRA can help?

A leak of hazardous material always poses some risk – the question is how significant is the risk and what are the potential impacts?

The QRA can provide an estimate of the associated risk (to people, assets, the environment). This information can be used as input to decision making process on how to approach the problem and establish what needs to be done.

14. If an existing QRA already available, will a new QRA will revalidate existing one or would you recommend to start from scratch and do a new QRA?

It depends on how easy it is to revalidate the existing QRA. For example – was it well documented? Can any changes in inputs be readily identified? Can source data files be found? Etc. Another factor is the scale of the data changes that are to be reflected in the new QRA e.g. have new process units being built/added to the facility in the intervening period?

There have been cases where the time needed to revalidate an existing QRA due to poor documentation was estimated to be significant enough to warrant doing a new study. Conversely, a qualitative evaluation of expected changes (i.e. new versus old) might lead to the conclusion that a new QRA is not needed.

To sum, it depends on the situation and the merits/demerits need to be judged on a case by case basis.

15. If I am very beginner in the QRA how much training I needed to perform a QRA?

An introductory course providing an overview (3-5 days) would be a useful introduction, but the best way to learn would then be to get practical experience, carrying out actual QRA work under the guidance of an experienced practitioner.

We (i.e. DNV GL) offer a range of training courses. We would recommend SA-02 Safeti training (this course introduces the concepts and models within Safeti software as well as introduces general concepts of QRA). More information can be found here.

16. If there is a difference between the main contributors to the risk profile and experience what might be the reasons. having validated the inputs to the model.

Various factors will impact upon the main contributors to the risk profile. For example:

- Location of the receptor
- Spatial distribution of risk/hazard sources (how big the site is, how spread apart/condensed are the hazard sources, proximity of the receptor to the risk source etc.)
- Extent of the consequence zones (fire, explosion size etc.)
- Type of hazard – vapour vs liquid hydrocarbons, flammable versus toxic
- Errors: e.g. in the model selection, use of inappropriate historical data.

17. Is QRA a methodology for SIL?

QRA and SIL are both risk assessment methodologies that are quantitative in nature i.e. the outputs are numeric. LOPA (Layer of protection analysis is another approach that provides quantitative output).

As a broad rule, they share very similar input data e.g. leak frequencies, probabilities etc.
Hence, data from a QRA study could be used as an input to a Safety Integrity Level (SIL) study, but would not constitute the SIL itself.

18. Is risk register a QRA methodology?
   A risk register providing a listing of risks/hazards associated with a facility, might be used as an input for a QRA, setting out what risks the QRA needs to model/capture.

   Outputs from a QRA can also be added to the risk register (i.e. as a measure of the magnitude of the risk, the relative benefit of any barriers in place etc.)

19. Is the flame out scenario of a flare covered in a QRA?
   Yes and no - depending on the specific scenario. It certainly could be included in a QRA, with the flame out potentially presenting a hazard which could be modelled. However, it is typically excluded on the basis of very low frequency and/or not being part of normal operations.

20. Is the hazard identification same as HAZID review? Is the hazard identification same as HAZID review?
   A formal HAZard IDentification (HAZID) workshop might well be used as the input to the hazard identification step in a QRA, setting out what hazards need to be addressed in the QRA.

21. Are there any mandatory requirement for offshore platforms?
   Yes, certain areas of the world have a local, country specific regulatory body which sets out the mandatory requirements for offshore platforms (e.g. UK HSE in the UK, NOPSEMA in Australia etc.) that necessitate the use of QRA (for e.g. where risk criteria are provided in numeric terms).

22. Is there a requirement to validate the QRA in a regular basis?
   This will depend upon local regulations. For e.g. with the safety case regime, there are certain triggers that require a reassessment of the safety case e.g. material changes to the process, every x number of years etc.

   Where a QRA has been used to support a safety case submission, then the QRA will need to be looked at again. This may require a review of the facility to ensure that none of the information the QRA is based on has changed, i.e. that the design/operation of the site has not changed. However, if it is shown that these have not changed, then the QRA is unlikely to require reperforming as there would be no change in the results.

23. There is always an acceptance criteria for IRPA and FN-Curves. How come that doesn't apply for PLL?
   This is the decision that has been made historically by various regulatory bodies. IRPA is a useful way of looking at the risk presented to specific individuals, while F-N captures the risk presented to a wider group.

   It is not clear what the exact reasons for this are, but PLL is heavily influenced by the number of people exposed to the risk meaning making it difficult to use as a criterion.

   IRPA and FN curves do not have the same limitation (although FN curves are also affected by the number of people exposed).

24. Is there any QRA table for leak of GNL from a tank?
   We take “GNL” to mean “LNG”.

   We are not aware of the concept of QRA tables.
This is because the outcomes of a risk tend to be quite specific as they involve the hazard interacting with the environment (e.g. weather, ignition sources etc.)

25. What are differences between QRA and risk priority number?
   An FMEA identifies the opportunities for failure, or "failure modes," in each step of the process. Each failure mode gets a numeric score that quantifies (a) likelihood that the failure will occur, (b) likelihood that the failure will not be detected, and (c) the amount of harm or damage the failure mode may cause to a person or to equipment. The product of these three scores is the Risk Priority Number (RPN) for that failure mode. The sum of the RPNs for the failure modes is the overall RPN for the process.

   A QRA on the other hand but approaches this from a more rigorous standpoint. For example, the amount of harm or damage the failure mode may cause is explicitly modelled via consequence analysis.

   A QRA also offers a visual depiction of risk providing a ready view of the extent of the risk and how it varies geographically. RPNs do not provide such a view.

   By using a common scale of reference or endpoint of concern e.g. likelihood of death or harm, QRA allows for risk contributors to readily identified.

   overall, QRA is more rigorous approach to quantifying risk than RPN's.

26. What are the main advantages/disadvantages of PHAST vs. SAFETI?
   Phast and Safeti are two different software tools designed for different activities.

   Phast is a software tool for Consequence/Hazard Analysis. Read more about Phast [here](#).

   Safeti is a tool for Quantitative Risk Analysis (QRA). Read more about Safeti [here](#).

   Consequence analysis is a key subset of Quantitative Risk Analysis – hence Phast is used as the consequence analysis engine of Safeti. This means that users of Safeti have access to Phast but not vice versa.

27. What are the new elements related to QRA emerging due to the high industry development in the world? For example Domino effects or Natech events
   This is somewhat outside of the scope of this webinar/ Q&A, but we would be happy to discuss this further on a one to one basis.

   The questioner should please get in touch with Kehinde.shaba@dnvgl.com.

28. What are the things/processes you cannot or might experience a lot of difficulty in assessing in a QRA.
   Matters (e.g. novel processes) which are uncertain or lacking in data or very unusual will generally require a lot more user judgement/ experience in order to be assessed successfully.
29. What are the typical factors or impact areas to be looked at while performing QRA study?
   This will depend on the objectives of the study which should be clearly defined at the outset. For e.g. the objectives might indicate the goal is to assess the risk to offsite populations, sensitive equipment etc.

30. What is a FN curve?
   A curve that shows the cumulative probability (f) of accidents that affect N or more people.
   The number of fatalities (N) is plotted on the x-axis against the Frequency (f) of N or more fatalities on the y-axis.
   FN curves aid in understanding the spectrum of risk as they demonstrate the progression of low-f (infrequent), high-N events to high-f (more frequent), low-N events.

31. What is "GIGO"?
   Garbage In - Garbage Out - i.e. no matter how good a model is, if the inputs are poor then the outputs will also be poor/unreliable

32. What is the difference between a QRA and an ALARP study, practically speaking?
   A QRA study would look at quantifying risks and establish where the risk lies relative to the criteria.
   This would for example identify that the risk to certain group or location is in the ALARP region.
   An ALARP study would look at the risk to determine whether the risks are indeed "As Low As Reasonably Practicable" i.e. determine if further mitigation measures can be considered.
   An ALARP study might also require quantifying the risk reduction that might be possible for various measures (thus necessitating a QRA) and evaluating whether it is practicable to implement them.

33. What is the difference between offshore and onshore QRA?
   The basis is the same and the event models may well be similar, but the differences in facility type often require a different approach to be taken in the software.
   The constrained space offshore often leads to different issues needing to be addressed.

34. What is the exact difference between PLL and F-N curve?
   PLL is a single number, the number of predicted fatalities in an average year, so containing data about all events, high & low frequency, high & low number of fatalities in a single number.
   The F-N data will present the same information but allows more of the information to be kept and presented, allowing determination e.g. are low frequency high fatality events more dominant or high frequency low fatality events.

35. What is the procedure to calculate the frequency of failure?
   This is usually based on combining historical failure data for equipment with a count of the number of pieces of equipment as well as the exposure duration. See the figure below for an example.
36. What kind of software can DNV provide to help doing QRA design? Please make a brief introduction
DNV GL currently offer two main QRA software applications:
1. Safeti Offshore for Offshore QRA (can also be used onshore). Read more here.
2. Safeti (for onshore QRA). Read more here.

37. When will DNV.GL bring training and certification in QRA/Safeti to Africa, specifically Nigeria?
We currently offer training and certification globally. Our training courses are in one of two formats:
- Public training (hosted by DNV GL and open to anyone to access)
- Private training (hosted and paid for by a company as a dedicated training session for staff)
In recent times, we have run several dedicated private training courses in Nigeria and South Africa.
Please contact Kehinde.shaba@dnvgl.com to discuss training opportunities in Nigeria further.

38. Why is it that the risk range for public/ workers on the ALARP Risk Triangle are mentioned as $10^{-3}$ to $10^{-5}$ or $10^{-3}$ to $10^{-6}$, whereas the FN curve for 1 person fatality is shown as $10^{-2}$ to $10^{-4}$? How does that work?
Data on the FN curve is cumulative (frequency of N or more) and thus not directly comparable to risk numbers shown in criteria.
Due to the cumulative nature, the FN curve will always show a high frequency of killing low numbers of people on the left-hand side of the curve (the peak of the cumulative curve); and a low frequency (relatively) of killing large numbers of people on the right-hand side.

39. Why we use risk with reference of per year?
This gives a reasonable scale/basis for comparison, which can be easily understood and which evens out day-to-day differences.
Furthermore, this is consistent with most accident statistics (e.g. number of people killed in motor accidents per year) which are given on an annual basis.

40. Will the QRA software provide us with the best initial frequency data? How to account for the sensitivity in differences in initiating frequency data?
This depends on the tool, but generally speaking, frequency data would normally be an input that needs to be provided to the QRA software.
Some QRA tools (e.g. Safeti offshore) incorporate leak frequency data.

The best way to account for differences is to via sensitivity analysis. Model multiple data sets and then compare the results.

41. Would you list a detailed methodology that lists the steps to be followed to develop a comprehensive QRA study, and the set of typical assumption made by DNV GL for performing a study (listing references used).


Please see the presentation slides for some useful references.

42. How the blowdown calculations will work in the simulation software?

Blowdown calculations will aim to model the real-life behaviour of the blowdown system by calculating the amount that can be discharged via the blowdown orifice and the associated reduction in system pressure.

The overall impact of blowdown will be shorter release durations and less material released.

43. Do you have a seminar about PHAST modelling?

We ran a session earlier in the year – “Introduction to Consequence modelling” where some consequence modelling examples were given using Phast. Please see here for more details and to access the webinar material (video and presentation).

44. Could you please provide us complete practical example for QRA?

This is somewhat outside of the scope of this webinar/ Q&A. A useful reference to consult would be "A Guide To Quantitative Risk Assessment for Offshore Installations" by John Spouge, published by CMPT, ISBN: 1 870553 365

45. Is building risk assessment always an integral part of QRA or it is separately assessed based on specific requirement?

It is not always an integral part of QRA, this would be on a case-by-case basis. However, if a QRA and building risk assessment are required for a site, it would make sense for them to be integrated, carried out as part of the same modelling, so as to be consistent.

46. Is there any planned advance webinar on PHAST and SAFETI modelling?

We have a rolling series of webinar planned for 2017/18 and these will be looking at a vast range of topics that will include PHAST and Safeti modelling.

Please keep an eye on our event page for details of future webinars.

We ran a session earlier in the year – “Introduction to Consequence modelling” where some consequence modelling examples were given using Phast. Please see here for more details and to access the webinar material (video and presentation).

47. Is QRA applicable only for plants and sites or can it be applied to processes as well?

QRA could be applied to anything where there are potential hazardous events. Most typically it is done for a site where there is a process being carried out that could lead to a leak of hazardous material (typically flammable or toxic), but this could be extended to many other things.

48. Are there any pre-requisites for QRA training? Have seen significantly different results for the same installation risk assessment.

Our Introductory QRA training is for beginners to the discipline so there are no prerequisites.
Please see our training page for dates of upcoming training sessions as well as what we offer.

There are many aspects when carrying out a QRA that will require user judgement, from selecting the events to model, to choosing probabilities, and many others. Each can affect the end result, and all combined can have a large impact. This is where proper documentation of the study, detailing the choices made and their basis is essential, for others to know what has been done and to be able to critique the study.

49. In case of lack of knowledge, how do you perform QRA? For both likelihood and severity of consequences.

The basis should be on making the best estimate possible, using historical references and where required, making a conservative estimation to be sure of not underestimating the risk.

50. Is there an available DNV GL study to be used as term of reference for in-house made QRA?

I am not aware of such a resource being available.

51. What type of cooperation with DNV GL can we do to achieve relative project? Software or other type?

We are open to any kind of collaboration and are happy to support to you to meet your business objectives.

This can be by (non-exhaustive list):
- offering technical safety consultancy services (e.g. QRA, HAZID, HAZOP, Safety Case etc.)
- Providing software tools such as Phast/Safeti
- Offering training
- Helping to develop and write company standards
- Reviewing documents for safety projects provided by third parties

Please contact myself (Kehinde.shaba@dnvgl.com) or Mark Hunter (Mark.hunter@dnvgl.com) to discuss this further.

52. Is QRA used for calculating the safety distances during finalization of layout?

This is one possible use of QRA results (among many others).

53. In LOPA studies we calculate Target Mitigated Event Likelihood. Is this an in-company Tolerable risk? And does it have to be in line with the risk curves shown earlier on in the presentation.

The evaluation criteria used in LOPA studies is different from that used in QRA.

54. How to monitor increase in risk with respect to time?

If risk increases over time then this would be due to some factor changing at the plant/site. This could be captured by changing the respective input (e.g. equipment failure data) to the QRA model to assess the changing risk.

55. Are there any updates coming up for the failure frequencies? UK HSEG is old now. Latest is by OGP from 2010.

Yes. Further updates are planned.

56. Can we compare result from QRA with Location class change survey for in service cross country pipeline?

Yes, you can.
57. What are the differences between Safeti and Safeti Lite?
   The differences are too many to list out here but Safeti Lite is limited in its ability to interrogate results, provide risk breakdowns, identify contributors etc. relative to Safeti.
   We have a comparison document that sets out the differences in functionality between both products. Please contact software@dnvgl.com for a copy of this.

58. If I have identical platforms, should I need to perform QRA for each platform or will a common QRA serve purpose for all?
   This will depend on the nature of the differences between the platforms. It is unlikely they are all identical in every way, exposed to the same environmental conditions. If they are, then certainly a QRA for one would apply for all. However, for non-identical platforms, if the only differences are relatively minor, and have no impact on the consequences of potential releases (or frequencies), and manning patterns etc. are the same, then a QRA of one should be applicable to others.

59. Does Dutch methodology (generic scenarios) help really on the decision support or at the end only guarantee the final risk calculation?
   We are not aware of a Dutch methodology that requires generic scenarios.
   The Dutch approach is centred on the principle that all QRA’s done for assets in Holland should have a comparable foundation – hence they should be based on the same assumptions, software models etc. The actual scenarios modelled will be reflective of the asset under consideration and not generic. This is the general thinking behind the reason why a customised version of Safeti – Safeti-NL is mandated for use in Holland.

60. Uncertainty in different models and tools used in QRA has being addressed by using punctual values. How important is to treat uncertainty and how far should that go?
   It is not clear what is meant by “punctual values”.
   Having said that, a QRA practitioner should understand the uncertainties of the input data and models they are using. This will give an idea of the scale of potential impact on the results, and can be tested by sensitivity cases tweaking key inputs to gauge the resulting impact on results.

61. What are the boundaries or factors to consider the incremental risk to the existing available risk due to the plant hazards?
   The question is not clear.
   We advise the questioner to please contact Kehinde.shaba@dnvgl.com or Mark.hunter@dnvgl.com to discuss the question.

62. Are there any free demo softwares that DNV-GL provides? If I dont want to buy software then does DNV GL can provide me QRA output by charging fees per output?
   Trial versions of Phast/Safeti are available for evaluation purposes and do not permit commercial use. Please contact software.support@dnvgl.com for details.
   For those not wanting to carry out studies in software themselves, DNV GL’s consulting division provide this service. Please contact mark.hunter@dnvgl.com to discuss this further.

63. What is the basis of selecting release duration for consequence analysis?
   The release duration is the time for which the release will last. This is calculated based on factors such as:
   - the isolated inventory available for release
- the release rate profile (driven by the pressure in the system)
- The presence of safety systems such as isolation and blowdown

The release duration has a direct impact on the magnitude of the consequences for e.g. how long a jet fire will last or how much flammable mass is available for an explosion outcome.

64. The pyramid on slide 12, that is the like risk categorisation matrix?
   It is similar, in terms of banding risk into tolerable/ALARP/Intolerable, but is considering risk only. A risk matrix would normally consider frequency on one axis and consequence on the other.

65. What is the difference between PRA and QRA?
   See response to question 3 above.

66. How does SAFETI handle showing different risk levels for scenarios with/without passive fire protection?
   This can be achieved by running different studies (with/without passive fire protection) and comparing risk results.

67. Do you consider the flame out scenario for flare (as discussed) a credible scenario? Don't we provide a Fuel Gas connection to keep pilots burning?
   It is certainly a credible scenario that a flare flame could go out, but it is not often part of a QRA.

   It certainly could be included in a QRA, with the flame out potentially presenting a hazard which could be modelled. However, it is typically excluded on the basis of very low frequency and/or not being part of normal operations. A fuel gas system is typically included in a QRA as it is a potential leak source like any other part of a process.

68. How to adjust release rate calculated by SAFETI to nominal flow rate?
   This would be best done using a user-defined case, generated from a discharge modelling case, where the release rate can be manually adjusted to be capped at the nominal flow rate.

   We are pleased to inform you that a new functionality call “flow control” will be introduced as part of the next version of Phast/Safeti (version 8).

   “Flow control” as the name suggests will allow users to directly specify the release rate they want to use in the modelling without the need to use a user defined scenario. This is a more user friendly and efficient way to approach this kind of analysis.

69. Do you have a SAFETI version for small plants that include only the basic?
   DNV GL currently offer two versions of Safeti for commercial purposes:
   - Safeti
   - Safeti Lite

   Safeti Lite enables a basic QRA to do done, but does not offer the full functionality of Safeti.

   Please read here for details of Safeti; and here for Safeti Lite.

   We also have a comparison document that sets out the differences in functionality between both products. Please contact software@dnvgl.com for a copy of this.
70. Is IRPA only for one person or it can be 1-2 persons?
   IRPA is the risk to a single person, but this could be an individual within a group who all have the
   same risk exposure as that person.

71. Can be the QRA based on generic scenarios really be used for ALARP demonstration of Major Risks?
   To fully capture the benefit of a QRA, we would recommend modelling actual as opposed to generic
   scenarios.
   That said, it is possible that due to asset similarity, generic scenarios can adequately describe the
   risks of a plant.

72. Which do you think are the most important events to take care of: the ones with high frequency and
    low consequences or the ones with low frequency and high consequences?
   There is no single answer here as it will depend upon the specifics of the case, the particular
   populations affected and the local/regulatory tolerance of risk.

73. What is the procedure for dividing Worst Case Scenario?
   Worst case scenario can be defined in many ways.
   In the context of a QRA, the worst-case scenario can be defined as the scenario with the largest
   contribution to the overall risk at a location, to a specific population group etc.
   Safeti includes functionality that produces a risk breakdown. This allows key contributors to risk to be
   identified.

74. How is QRA used to make decisions related to the layout of plant?
   Decisions related to layout would mainly be either changing the location of release sources to change
   the area impacted by risk from those sources, or changing the location of other plant items (such as
   buildings or populations) to place them in areas of lower risk.
   See response to question 77 below.

75. What is the difference between SAFETI vs PHAST?
   See response to question 26 above.

76. Where do I get blast pressure impact and consequence death guidance? I.e. at what pressure a
    person will die? Are there any body publishing these research number?
   There are many possible sources. Some examples are:
   - UK HSE (http://www.hse.gov.uk/foi/internalops/hid_circs/technical_osd/spc_tech_osd_30/)
   - OGP RADD
   - Lee's Loss Prevention in the Process Industries
   - TNO "Coloured books"

77. What is the difference between QRA and FSS? Facility Siting Study
   From a technical safety perspective, a facility siting study aims to establish the best location for a
   facility (or building within it) based on safety/risk concerns.
   A QRA can be used to calculate the risk profile for the facility to understand the high/low risk areas,
   spatial distribution of risk, risk drivers etc.
Consequently, the results of a QRA can be used as a basis for determining the facility siting requirements.

78. Is HAZID a standard requirement for first activity or can HAZOP can also be considered? Which one should we use - HAZID or HAZOP?

A HAZID would often be used as an input to a QRA, but is by no means necessary. The first step is to consider the overall site and work out what the hazard sources are that should be included in the study. This could come from an existing HAZID/HAZOP, or could be done specifically for the QRA.

79. What is the range of risk for three bands and what is acceptable worldwide?

There is no universal value, they vary between countries. Publications from regulatory bodies should be consulted for specific country guidance.

80. It would be very useful to understand the "State of art" of how this kind of assessment should be developed. Could you provide a detailed methodology, describing step by step the necessary part to be developed, the typical assumption (and the references used), the most common tip and pitfall that can be envisaged? Is it possible to consult DNV report studies?

This is somewhat outside of the scope of this webinar/ Q&A. A useful reference to consult would be "A Guide To Quantitative Risk Assessment for Offshore Installations" by John Spouge, published by CMPT, ISBN: 1 870553 365

Also, see the references slide supplied as part of the webinar presentation.