SUMMARY

RESULTS DIFFERENCES FROM 6.7 TO 8.21 OF PHAST AND SAFETI

DATE: December 2023

This document lists enhancements and bug fixes in Phast and Safeti between versions 6.7 and 8.21, which affect results.

No.	Date	Reason for Issue	Prepared by	Verified by	Approved by
1	Sep 2017	Phast and Safeti 8.0	Henk Witlox	Stene, Harper, Oke, Xu and Worthington	
2	March 2018	Phast and Safeti 8.1	Henk Witlox	Harper and Oke	
3	May 2019	Safeti and Safeti NL 8.21	Henk Witlox	Harper and Worthington	
4	May 2021	Apply new template	D. Vatier		
5	Oct 2023	Update document title to reflect applicable versions	W. Place	D. Worthington	

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ABSTRACT

This document lists enhancements and bug fixes in Phast, Safeti and Safeti-NL 8.0, which will give different results.

The document is further updated to list additional 8.1, 8.2 and 8.21 modifications, which affect results.

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1 LIST OF PHAST AND SAFETI MODIFICATIONS AFFECTING RESULTS

The tables below list the major enhancements and bug fixes in Phast and Safeti 8.0, which would affect result differences between versions 6.7/7.21 and 8.0. These results differences are based on default parameter settings in both 8.0 and 6.7/7.21. The document is further updated to list additional 8.1, 8.2 and 8.21 modifications, which affect results.

Table 1, Table 2, Table 3, Table 4, Table 5, Table 6 and Table 7 include results differences for modelling of mixtures, discharge, pool spreading/evaporation, dispersion, toxics effects, flammable effects, and risk, respectively. The subsequent columns include the following:

- The first column includes the name of the 8.0 parameter tab, where the enhancement can be switched off in case this is possible. Otherwise it indicates whether the enhancement can be applied by added input, or in case the enhancement will always be applied (and cannot be switched off).
- The second column refers to the Phast/Safeti model for which the enhancement or bug fix applies.
- The third column briefly summaries the 8.0 enhancement or bug fix.
- The fourth column summarises the effect of the 8.0 enhancement or bug fix on the results.
- The fifth column includes a reference to a Phast/Safeti 'Technical Documentation' document (or Phast/Safeti Help), where more detailed information can be found regarding the enhancement. For an overview of the new modelling enhancements in 8.0, see also the document 'New modelling in Phast and Safeti.pdf' which is part of the Phast/Safeti 'Technical Documentation'.

As part of a separate exercise, result differences were compared between Safeti-NL 6.54, Safeti-NL 6.7 and Safeti-NL 8.0 for a very large number of QRA's in the Netherlands and the results of these have been accounted for below. For these studies, the most frequent reasons for differences in results were as follows

- For instantaneous 2-phase releases we have introduced an improved more accurate model, for which there may be significant amount of rainout which may often (but not always) result in reduced concentrations and overall reduced risk (although for some limited cases it may increase risk, e.g. because of increased pool fire risk)
- For releases with rainout and for time-varying releases, 8.0 now accounts for along-wind-diffusion which reduces concentrations in the far-field and which may significantly reduce risk particularly in the far-field for toxic releases.
- For heavy-gas releases with low wind speeds, the UDM downwind gravity spreading correction may lead to more narrow and longer clouds.
- For high-pressure hydrogen and methane vapour releases removal of the velocity gas of 500 m/s, results in reduced concentrations in the near-field, and in case of horizontal releases quite often increased concentrations in the far-field (because of less plume rise).
- We have introduced a new more accurate dynamic fireball model which often results in reduced risk (except close to release point where there may be increased risk). In addition, we now impose always a radiation dose lethality criterion (no longer 100% lethality if radiation 35kW/m2) and this further reduces risk particularly for the new fireball model where the fireball rises.
- For warehouse fire models (or other toxics releases with low toxics hazard distances) a finer resolution of toxicity calculations may result in more accurate toxics and risk predictions in the near-field.

parameter tab	Model	8.0 Enhancement	Effect on results	Reference
<no parameter>	Mixtures (affects all models)	**(bug in 8.0,8.1 - not in 6.7; fixed in 8.2)** Order of components in a mixture can affect results (if re-ordered after creation)	May increase or reduce hazard/risk distances	

Table 1. Mixture modelling

parameter tab	Model	8.0 Enhancement	Effect on results	Reference
<no parameter>	DISC line rupture	**(bug in 8.0,8.1 - not in 6.7; fixed in 8.2)** Incorrect modelling of upstream pressure for short pipe scenario with fixed flow rate and non-zero liquid head. Liquid head was incorrect included in calculations	Too high flow rate in 8.0 and 8.1, and therefore too large hazard/risk distances	
<no parameter>	DISC line rupture, relief valve or disk rupture	In 6.7/7.2 (not time-varying) specified inventory referred to all mass (vessel mass + pipe mass), while in 8.0 it refers always to vessel mass only	Increases released duration (if 6.7/7.2 duration < max. duration), and hence concentrations and risk may increase; when upgrading, a warning will be produced if added pipe mass > 10% of vessel mass	DISC theory
<no parameter>	TVDI time-varying discharge model	In case of liquid storage (specified vessel dimensions), 6.7/7.2 specified vessel inventory included liquid mass only while in 8.0 it includes both vapour and liquid	For liquid storage, this slightly decreases total vessel mass (particularly if liquid volume much less than overall volume, and/or for high pressure storage); this may slightly decrease concentrations and risk	TVDI theory
<added input>	DISC&TVDI	Added option to specify vessel fill grad for liquid storage (TBC)	No changes in DISC results if 100% fill grade	DISC&TVDI theory (to be added)
discharge parameters / discharge parameters	DISC leak discharge model	Expansion from stagnation to orifice conditions (leak scenario): added new default option of metastable liquid, while allowing vapour to 2-phase expansion	Avoids 6.7/7.2 DISC 32 error and potential erroneous 6.54 result; potential increased liquid orifice fraction. No changes in case of vapour to vapour expansion; otherwise may slightly reduce flow rates for smaller pressures, and significantly increase flow rates for larger pressures. Particularly for supercritical storage conditions, flow rates may increase significantly.	DISC theory
discharge parameters/ time-varying releases	TVDI time-varying discharge model	More robust solver for time-varying discharge model TVDI. This includes convergence behaviour near critical point, although some convergence issues remain.	(1) avoid 6.7 numerical oscillations, (2) avoid premature termination (this may increase released mass in 8.0, and therefore increase risk), (3) avoid occasional erroneous release of liquid after liquid level dropped below the hole height (this may reduce released mass and hence risk in 8.0)	TVDI theory

Table 2. Discharge modelling (first part)

parameter tab	Model	8.0 Enhancement	Effect on results	Reference
<added input>	GASPIPE and PIPEBREAK long pipeline models	Add crater effects for long pipelines	Added initial entrainment (reduced near-field concentrations) and reduced release velocities; does not affect upgraded studies (no crater effects)	Crater report
<no parameter>	GASPIPE long pipeline model	Modified more refined modelling of flow following valve closure, where disturbance propagates from the closed valve	This changes avoids sudden discontinuities at the time of valve closure, and results in more realistic discharge predictions.	GSPP theory
<bug fix>	GASPIPE long pipeline model	Corrected valve close interpolation errors	This change may for some cases avoid sharp erroneous discontinuities of the flow rate. This it would avoid oscillation of flow rate immediately at time when valve close. This change would normally not affect risk results.	
<bug fix>	GASPIPE long pipeline model	Corrected choked flow calculations	This may avoid for some cases very strange behaviour of the predicted release rate from the upstream branch. This change will increase release rate and choke pressure from the upstream branch, and slightly reduced the release rate from the downstream branch.	GSPP theory
<bug fix>	Long pipeline GUI	**(bug in 8.0,8.1 - not in 6.7; fixed in 8.2)** For studies that generate Rationalised Discharge Scenarios as part of the run, if the study has been run in parallel, or saved and re-opened after a series run, then the playlists for these rationalised discharge scenarios may be incorrect	incorrect discharge results and hence incorrect concentrations/risk in 8.0 and 8.1	
<removed input in 8.0>	GASPIPE and PIPEBREAK long pipeline models	Removed in 8.0 and 7.2 option of stagnation temperature to be equal to ambient temperature	This results in differences with 6.7 results, in case the user specified the ambient temperature as stagnation temperature as input for the long pipeline model. For upgraded studies 7.2/8.0 ignore this input, and apply the stagnation temperature specified in the Material tab instead. The larger the difference between the latter temperature and the ambient temperature, the larger differences in results are expected.	Phast/Safeti Help
discharge parameters/ discharge constants	ATEX atmospheric expansion model	ATEX expansion from orifice/pipe-exit to ambient conditions: remove cap of 500m/s for post-expansion velocity.	Affects pressurised releases for materials lighter than air (hydrogen and methane); larger release velocities result in more jet entrainment and hence reduced concentrations near-field; for horizontal buoyant releases less plume rise and hence possibly larger concentrations in the far-field. For vertical releases, the larger velocities may for some cases result in more cooling of the plume, less plume rise and hence larger concentrations and risk.	ATEX report
discharge parameters/ discharge parameters	ATEX atmospheric expansion model	New ATEX expansion method: apply conservation of momentum always for vapour and CO_2 releases (future: also apply for other releases)	Mostly no change expected, except for CO_2 releases; changing from isentropic to conservation of momentum (always recommended if no rainout) typically results in reduced speeds and hence reduced jet entrainment (larger concentrations)	ATEX report

Table 2. Discharge modelling (second part)

parameter tab	Model	8.0 Enhancement	Effect on results	Reference
	POOLS			
<no parameter>	PVAP	More robust solution of pool spreading/evaporation equations	Avoids unphysical oscillations (normally negligible effect on risk)	PVAP Theory
pool vaporisation parameters	PVAP	New default MacKay and Matsugu correlation for evaporation on land	Reduced evaporation rates for pools on land (after rainout on land), resulting in reduced concentrations and (in case of flammable) larger late pool fires; more pronounced effect for atmospheric storage tanks with almost 100% rainout	PVAP Theory
<no parameter>	PVAP/UDM	Pool centre can move upwind when the edge intercepts a bund wall	This means that vapour will be added to the cloud more upwind, typically leading to less conservative predictions (lower concentrations and lower risk)	UDM theory

Table 3. Pool spreading/evaporation modelling

parameter tab	Model	8.0 Enhancement	Effect on results	Reference
dispersion parameters / near-field	INEX (UDM)	New INEX model for initial dispersion phase for pressurised instantaneous releases; unlike old INEX, the cloud geometry accounts for effect of the ground (not spherical), gravity effects (does not stay horizontal during INEX stage), and time-varying rainout while touching down (old INEX droplet move along one single upward angle), transition to UDM when INEX entrainment/spreading rate reduces to UDM entrainment/spread rate (old UDM dR/dt<1m/s)	Often smaller concentration and doses, and (for two-phase releases) more rainout. The increased amount of rainout can increase risk due to pool fires (in case of flammable release), while the reduced concentrations can reduce risk (due to delayed explosions and flash fires). Note for some cases, significant evaporation from the pool (after rainout), may in fact increase risk due to larger delayed (or free-field) flash fires combined with the late pool fire (with pool fire risk often absent in 6.7/7.2)	UDM INEX report
dispersion parameters / near-field	INEX (UDM)	Unpressurised instantaneous releases have their droplets starting at 0m downwind to bring them into line with new INEX calculations	This will avoid possible erroneous rainout outside the bund which was present prior to v8 (with inclusion of bunds in 8.0 leading to smaller pools, i.e. less risk due to pool fires and less evaporation and hence lower concentrations). In case no bund effects are applicable, rainout will be more upwind again being less conservative.	UDM INEX report
Surface parameters / Bund properties	UDM	For instantaneous releases a multiplier is applied to the size of the bund. The default value is 1.5, corresponding to recommendation following experiments by HSL (from overflow measurements for catastrophic ruptures).	This will not affect the results for upgraded studies, since for these a multiplier of 1 is applied. For new studies, the user should be aware that by default the program uses a larger bund area for instantaneous releases than non-instantaneous releases.	
<no parameter>	UDM	Observer logic instead of 6.7 discontinuous segment logic; more robust cloud/pool linking	Moore smooth and realistic results; may result in both reduced or increased concentrations (more effect if larger amount of rainout or time-varying releases). For time-varying long pipeline runs (or time-varying TVDI runs with large hole sizes), there will be a very quick drop in flow rate, and therefore the initial 8.0 observer flow rate may be significantly larger than the first 6.7/7.2 segment rate. This may result in larger concentrations and risk in the near-field.	UDM theory
<no parameter>	UDM	Different approach to modelling dispersion from pools and pool sources. Dispersion now starts from the upwind edge of the pool, and observers pick up mass as they traverse it. The shape of the cloud conforms more to the pool shape	Clouds can start from upwind of the release point. Near-field cloud geometry more realistic, though artefacts can occur if the pool spreads upwind rapidly and at the release point	UDM theory

Table 4. Dispersion modelling (first part)

parameter tab	Model	8.0 Enhancement	Effect on results	Reference
dispersion parameters / time-varying and finite duration	UDM	Allow for gravity spreading in crosswind and downwind directions; reduces cloud width and increases cloud length	Less wide and more long clouds in case of low wind-speeds for heavy-gas grounded releases with large release rates. This may increase the maximum concentrations in the near-field (and reduce the cloud width).	UDM theory
dispersion parameters / time-varying and finite duration	UDM	Apply observer mass correction (imposes conservation of mass) if observers move with different speed. The observer mass correction is carried out after time-shift logic to prevent observers approaching too close to one another.	For reducing release speed / flow rate, observers will move away from each other resulting in reduced concentrations; compared to 6.7 predictions, doses are smaller if N>1; for other scenarios observers may approach each other, resulting in increased concentrations	UDM theory and UDM time-varying verification
<no parameter>	UDM	**(8.1 enhancement)** Using the above observer release logic, a 'conservation of overall released mass' check is applied at the furthest downwind edge of the pool. In case this check is not satisfied, alternative more simple modelling is applied. In 8.0 the pool was replaced with an equivalent steady-state pool, while in 8.1 for rapidly evaporating pools the release may instead be modelled as an instantaneous release (with subsequent pool evaporation).	Mass conservation errors are less likely to occur in 8.1 than in 8.0. In case the equivalent pool approach was selected in 8.0 for a rapidly evaporating pool, the release may be instead be modelled in 8.1 as an instantaneous release typically resulting in increased concentrations. Also for cases where the equivalent pool approach was not used, results may change slightly because of refined observer release logic.	UDM theory
<no parameter>	UDM	**(bug in 8.0,8.1 - not in 6.7; fixed in 8.2)** Mass conservation related problem. Observers travelling over pools could sometimes stop early, and their mass could be missed by mass conservation checks. This could lead to UDM3 188 or 189 errors, or incorrect results	Possibly too low concentrations and hence too low risk in 8.0 and 8.1	
<no parameter>	UDM post-processing	**(no issue for 6.7; 8.2 bug fix)** Scalloping significantly reduced for max footprint graphs (no known scaloping in existing studies)	More smooth concentration and hence even more smooth risk contours	
dispersion parameters / time-varying and finite duration	UDM	New 'along-wind-diffusion' option, replacing the QI (Quasi-Instantaneous) transition option as the default. Please note that for simplicity, currently explosion calculations are based on pre-AWD flammable mass rather than AWD flammable mass, but these masses are normally expected to be very close.	Avoids arbitrary discontinuity as was applicable for QI transition; avoids too small instantaneous plume concentrations after QI; reduces maximum concentrations in the far-field due to along--wind diffusion; relevant for time-varying releases, releases after rainout; and for finite-duration releases (typically for downwind distance x larger than the product of the wind-speed ua and the travel time t: x > ua*t); most relevant for toxic releases and less for flammables	UDM theory
dispersion parameters / far-field	UDM	New default mixed-basis stop criterion; calculations are always carried out until the furthest distance required. For Safeti this will distances up to intervention values, if these are specified. For Phast, it will include distances out to the minimum lethality for toxic releases.	Avoids previous inaccurate large 6.7 interpolation errors because of too large (toxics) step sizes in the near-field; ensures sufficient small steps up to 1% probability of death as for Risk-based criterion. For Phast, toxic hazard zones will always be fully developed and therefore may appear larger than in previous versions.	Phast/Safeti Help
<obtain original results by running scenario in Phast instead of Safeti>	BWM in Safeti and Safeti-NL only	In Safeti & Safeti-NL 8.0 (not Phast), the GUI automatically replaces input to the building wake model: (1) building angle and wind angle reset to zero, (2) rectangular building with width B and length L replaced with equivalent square building of same area [with width = length = sqrt(BL)]. This automatically applies the recommended input for most accurate risk calculations.	Safeti applies zero risk inside the building, a uniform risk inside the building wake and reducing risk further downwind. This enhancement may reduce or increase the zero risk zone, in case of a non-rectangular building, and it will also effect the size of the building wake (and hence the risk inside the building wake). Most significant changes are expected for more non-square buildings as well as larger differences between building angle and wind angle.	BWM theory

Table 4. Dispersion modelling
(second part)

parameter tab	Model	8.0 Enhancement	Effect on results	Reference
	TOXICS			
<cannot change in 8.0, but can change in 6.7 and 6.54>	TXCS/MPACT in Safeti-NL only	Indoor toxic method now used instead of applying vulnerability factor 0.1 to outdoor results	Could increase risk (if population sufficiently close to release, i.e. probability of death > 0.1) or decrease indoor toxic risk (if population sufficiently far, i.e. probability of death < 0.1)	TXCS Theory
654/67 general risk parameters, 80 toxics parameters	TXCS	toxics step sizes by default 25m in 654/67, while in 80 default 99 steps (of equal length) up to 1% probability of death for each weather/scenario	Could significantly increase resolution in near-field of toxic lethality contours and therefore also modify risk contours. This is particularly relevant in case toxics hazardous distance are not significantly larger than 25m, which is for example often the case for warehouse fires.	Phast/Safeti Help

Table 5. Toxic effects

parameter tab	Model	8.0 Enhancement	Effect on results	Reference
Fireball and BLEVE blast parameters / BLEVE Blast parameters	BLEVE Blast model	One additional non-default 'Brode option' available in case of real-gas modelling (recommended option by Air Product)	Not used for risk calculations. No change in results if default option is used.	BLEVE Blast Theory
Fireball and BLEVE blast parameters / Risk	TVFM fireball model	New dynamic time-varying fireball (starting from ground and subsequently rising). The old default model assumed the fireball to be static at a fixed height during the fireball duration.	Increased near-field G/L radiation and reduced in far-field	Fireball report
Flammable parameters / Flammable risk	RADS radiation model	**(8.0 enhancement superseded by enhancement below)** Always impose radiation dose lethality criterion outside flame (fireball, jet fire or pool fire; increase 35kW/m2 to 400 kW/m2)	Reduced fire radiation lethality in particularly in conjunction with the time-varying fireball model; for pool fires and jet fires reduced lethality only if fire duration < 20s	Phast/Safeti Help
Flammable parameters / Flammable risk; Fireball and BLEVE blast parameters / constants; Pool fire parameters / Pool fire reference data; Jet fire parameters / Jet fire reference data	RADS radiation model	**(8.1 enhancement superseding enhancement above)** Prior to v8, 100% indoor and outdoor lethality was always assumed for jet fires, pool fires and fireballs at locations with radiation exceeded the critical level of 35kW/m2. For Safeti-NL 8.1, this has been modified, such that now 100% lethality is assumed instead at locations with radiation dose exceeding (20s)*(35kW/m2)**4/3. For Safeti this modification has been applied for fireballs only, although the user has the option to use radiation dose based criteria for jet fires and pool fires as well.	Reduced fire radiation lethality in particularly in conjunction with the time-varying fireball model; in case of Safeti-NL, for pool fires and jet fires reduced lethality only if fire duration < 20s	Phast/Safeti Help
	jet fire model	**(8.1 enhancement)** Before 8.1 the averaging method to obtain jet-fire model input data (flow rate and post-expansion data) for time-varying releases was identical to that used for the dispersion model inputs. However, for multiple segment releases additional averaging was done using the segment results over the 'jet fire averaging time' (20 seconds by default). In 8.1 jet fire averaging for (a) 'average rates'; and (b) 'multiple rates' is done by averaging the raw discharge results over the 'jet fire averaging time'.	Identical results are obtained in case of the default settings (averaged rate between two times), or rate at a given time. For 'multiple rates' the new averaging calculation may increase or decrease jet fire flow rate and risk. For 'average rates' where 'duration of interest' is greater than the 'jet fire averaging time' there will normally be an increase in jet fire flow rate and risk	
Jet fire parameters / Jet fire reference data	JFSH jet fire model	Reduce jet fire maximum SEP from 400 to 350 kW/m2	Only reduces radiation for jet fires for which previously predicted radiation > 350kW/m2	JFSH report
Jet fire parameters / Jet fire	JFSH jet fire model	Flame-shape adjustment if grounded	Reduces radiation at ground-level if jet fire hits the ground. Particularly relevant in near-field.	JFSH report
<Risk> input tab	standalone jet fire model	**(8.2 enhancement)** Option of uniform versus windrose risk distribution for jet fire	No change in results in case default option of uniform distribution is applied	
<no parameter>	explosion in Phast only	Explosion Location Criterion 'Cloud Front (LFL)' no longer supported in Phast, and for upgraded studies 'Cloud Front (LFL fraction) is used instead. This is not relevant for Safeti risk calculations for which always the cloud centre is adopted.	More conservative results (distance to given overpressures further downwind)	
<no parameter>	explosion	Flammable time steps are now calculated by dispersion post-processing model CVIEW and cover the ground more rigorously and will in general have more cloud views	Smoother and more correct explosion results. Thus this could increased or decrease overpressures	
Pool fire parameters /Pool fire	pool fire model	**(8.2 enhancement; not NL)** New default option in 8.2 of two-zone fire modelling for smoke flammable materials	The new default results in larger near-field radiation predictions, and the same results in far-field	
<bug fix>	POLF/XPRP pool fire property	Mixing rule for smoky/luminous fires (smoke if smoky components are heaviest, luminous otherwise) now exclude toxics and inert masses	Potentially changes results for mixture with both flammable and non-flammable components (scenarios with pool fire present), in case resolution of error results in mixture to be changed from luminous to smoky (typically reduced risk)	Material property database report

Table 6. Flammable effects

parameter tab	Model	8.0 Enhancement	Effect on results	Reference
	RISK			
<bug fix>		**(bug fixed in 8.2; not applicable for NL)** Flammable releases with no flammable cloud (e.g. low volatility spills) can be missing risk due to delayed ignition (e.g. pool fires)	Larger risk results in 8.2	
<no parameter>		**(8.12 enhancement - NL only)** Modified modelling of immediate ignition events for risk calculations for flammable instantaneous releases from mounded tanks. For 6.54 event tree probabilities were 0.18 (immediate flash fire + pool fire) and 0.12 (immediate explosion and pool fire). In 8.0 and 8.12 event tree probablity was 1 (pool fire only). In 8.2 it is 0.3 (fireball and pool fire).	Risk predictions may reduce or increase. For most cases, they are however expecton to increase due to inclusion of fireball in Safeti-NL 8.2.1 and not in Safeti-NL 6.54	MPACT theory
<no parameter to revert to old route method>	Long pipeline section breach	New method (available in 7.21 with many refinements afterwards) for risk calculations along pipelines replacing previous route method. This includes involves more accurate multiple discharge/dispersion calculations along the pipe and includes automated event spacing logic.	In general, more accurate and better resolution of risk contours. In case the user would have previously applied a worst-case assumption of a hole in the middle of the pipe, he would now obtain less conservative results.	Route theory
General Risk Parameters / IRISK	IRISK	New IRISK model for individual risk calculations	More fast risk calculations; overall risk contours are expected to be more smooth and very close to 6.7 results	MPACT theory
Risk preferences / Contours	MPACT/CVIEW/ IRISK	(new in 7.21) Increase from 40,000 to 160,000 risk grid cells used for risk arrays and contouring; 21 downwind distance steps used for cloud views for radiation, flash fire and explosion effects.	Smoother and more accurate risk results.	Phast/Safeti Help
<no parameter>	MPACT	(new in 7.21) Increased resolution of FN curve	More accurate FN curve	Risk results theory
<no parameter>	CVIEW dispersion post-processing	Flammable time steps are now calculated before the risk calculations in the CVIEW model and cover the ground more rigorously and will in general have more cloud views (see also above)		
Event tree parameters / "Instantaneous -no Rainout" and "Instantaneous - rainout"	MPACT	(change only applicable for Safeti-NL, not for Safeti commercial) Fireball with immediate pool fire only (probability 0.7 --> 1); remove immediate flash fire (0.18->0) and explosion (0.12->0)	Increased fireball risk; however in conjunction with new time-varying fireball model and new radiation lethality criterion the overall net effect is typically reduced lethality	MPACT theory
<bug fix>	MPACT	(new in 7.21) Number of people exposed to toxic cloud was too high and could have resulted in too much spread on the FN curve	incorrect F/N curve	MPACT theory
<bug fix>	MPACT	(new in 7.21) Remove grid dependency for ignition presence factor < 1	Modifies risk results if ignition presence factor < 1 (increase or reduce)	MPACT theory
<bug fix>	MPACT	(new in 7.21) Issues with the flammable cloud footprint at the effect height - e.g. 6.7 incorrect too small time for a free-field scenario, some odd looking risk contours	Too low risk (free-field LFL cloud too small and free-field flammable mass for explosion too low). In case this erroneously causes the LFL cloud not to exceed the plant boundary, it may result in considerably too small risk.	MPACT theory
<no parameter>	RiskRes	(new in 7.2) A new model to accumulate risk at the report level	Faster reports and ability to discard lowest level details (no result change)	Risk results theory
	GUI			
General parameters / General reference data	footprint plots	Single effect height replaces toxic and flammable effect heights	No changes in results for NL, since flammable = toxic effect height = 1m; may affect commercial version	GUI Help

Table 7. Risk modelling

About DNV

We are the independent expert in risk management and quality assurance. Driven by our purpose, to safeguard life, property and the environment, we empower our customers and their stakeholders with facts and reliable insights so that critical decisions can be made with confidence. As a trusted voice for many of the world's most successful organizations, we use our knowledge to advance safety and performance, set industry benchmarks, and inspire and invent solutions to tackle global transformations.

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DNV is a world-leading provider of digital solutions and software applications with focus on the energy, maritime and healthcare markets. Our solutions are used worldwide to manage risk and performance for wind turbines, electric grids, pipelines, processing plants, offshore structures, ships, and more. Supported by our domain knowledge and Veracity assurance platform, we enable companies to digitize and manage business critical activities in a sustainable, cost-efficient, safe and secure way.

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