Introduction

- Motivation
  - Provide technical bases for consequence analyses using MACCS
    - MACCS is capable of calculating land contamination, doses to individuals and populations, health effects and risks, and economic losses resulting from an accident
  - Regulatory applications of MACCS require model input parameters have a defensible and transparent basis
  - Encourage consistent MACCS parameter usage among the MACCS user community
- The existing basis for the parameters was identified and updates were based on current data and information

Previous Parameter Guidance

- Many of the parameter values initially used in MACCS were developed in the 1970's and 1980's to support early code versions
  - CRAC and CRAC2 for The Reactor Safety Study (WASH-1400)
- Sample Problem A
  - MACCS was distributed with a sample problem used to illustrate the use of MACCS and to test proper operation of the code
  - Sample Problem A parameter values based on NUREG-1150
  - Technical bases for many of these parameters are documented in NUREG/CR-4551 Volume 2, Part 7
  - Sample Problem A was updated with the release of MACCS2

Previous Parameter Guidance

- NRC and European Commission studies – 1990s
  - NUREG/CR-6545 and NUREG/CR-7161
  - Sought to develop credible and traceable uncertainty distributions for non-site specific input variables identified to be important to, or significant for, determining off-site consequences with the then new probabilistic accident consequence codes MACCS and COSYMA
- State of the Art Consequence Assessment (SOARCA) – 2010s
  - SOARCA developed ‘best-estimate’ values for use in severe accident and consequence modeling
  - NUREG/CR-7009, "MACCS2 Best Practices as Applied in the State-of-the-Art Reactor Consequence Analyses (SOARCA) Project"
  - Provides SOARCA parameters and additional detail on methodologies and best practices for developing MACCS parameters

Scope and Limitations

- Current input parameter guidance document is intended to cover a broader list of parameters than those addressed in NUREG/CR-4551 Volume 2, Part 7
  - Code modifications and additions since MACCS2
  - Dosimetric data and health effects addressed elsewhere in NUREG-1150 documentation
- Wide range of sources reviewed included documentation from DOE, NRC, SNL, journal articles, technical reports, and information from other domestic and international entities
- Limitations
  - Values and recommended approaches not intended to be “defaults”
  - No comprehensive evaluation of COMIDA parameters
  - Parameters based on current public code version (Version 3.10)

Parameter Guidance Document Format

- The document is structured roughly based on the eight technical elements defined in the ASME/ANS Level 3 PRA Standard, RA-S-1.3-2017: Standard for Radiological Accident Offsite Consequence Analysis (Level 3 PRA) to Support Nuclear Installation Applications
- Level 3 PRA Technical Elements
  - Radionuclide Release Characterization (RE)
  - Protective Action Parameters and Other Site Data (PA)
  - Meteorological Data (ME)
  - Atmospheric Transport and Dispersion (AD)
  - Dosimetry (DO)
  - Health Effects (HE)
  - Economic Factors (EC)
  - Consequence Quantification and Reporting (QT)

Parameter Guidance Document Format

- Technical element area or group of technical elements
  - MACCS-specific parameter considerations to support that technical element
    - Parameter name
    - Recommended Value
    - Uncertainty Range
    - References
    - Further discussion related to parameter value considerations

Guidance Document Example – Core Scaling Factor

- Technical Element: Radionuclide Release Characterization
  - Identification of Radionuclides and Development of Radionuclide Inventory
    - Parameter name: CORSCA
    - Recommended Value: Problem-specific; normally 1 if a problem-specific inventory has been developed
    - Uncertainty Range: N/A
    - References: (Chanin & Young, 1998)

      If a plant-specific core inventory has been developed, the core scaling factor should be set to unity. The core scaling factor may be used to scale the inventory for minor changes in inventory. For example, the analyses in NUREG-1150 scaled a reference inventory by the ratio of the power level of each individual unit to that of the reference unit.

Updated Guidance Example

- The guidance in the report reflects updates and lessons learned from recent consequence analysis projects
- As an example, surface roughness affects on vertical dispersion
  - Surface roughness affects both vertical dispersion and dry deposition velocities
  - Surface roughness is not a direct input into MACCS, but is used to adjust vertical dispersion coefficients for different terrain roughness relative to those used to derive the dispersion coefficients (i.e., via the ZSCALE input parameter), as well as to estimate dry deposition velocities (via the VDEPOS parameter)

Guidance Example Continued

- Average weighted surface roughness lengths can be computed using site-specific land use and ground cover information obtained from the USDA CropScape Database (http://nassgeodata.gmu.edu/CropScape/)
- It is recommended that two different surface roughness lengths be determined and applied to ZSCALE and VDEPOS
  - ZSCALE is derived based on surface roughness characteristics within a few kilometers (~8 km) of the release location
  - The surface roughness length used in deriving VDEPOS is based on a larger region around the release location (~80 km) due to the typically slow rate of plume depletion by dry deposition

Updated Cost and Decontamination Parameters

- The last major review and update of MACCS cost parameters was conducted in support of NUREG-1150
  - Since that time, there have been advancements in technologies, economies of scale, and lessons learned that have occurred through large scale decontamination and demolition of many DOE sites, and more recently at Fukushima
- 32 input parameters related to decontamination and protective measures were updated
- Developed a table of recommended values for all MACCS decontamination and cost parameters
- Where practical, a process was described which analysts may implement to update or develop site specific parameters

Updated Cost and Decontamination Approach

- For the parameters related to decontamination, current national and international practices, including the ongoing Fukushima activities were investigated
- Decontamination costs were determined for farmland and non-farmland regions
- Cost considerations for various decontamination factors include
  - radioactivity sampling and waste characterization prior to clean up
  - waste transportation, storage and disposal costs
  - decontamination surface (asphalt, roofing, landscape, etc.)
  - decontamination technology (sandblasting, pressure washing, etc.)

Input Parameter Application Guidance

- Appendix provides analyst guidance on which MACCS should be changed, when to change them, and documentation expectations when those parameters are applied

	Nomenclature Guidance	Documentation Expectations
Standard	Standard value that should not be changed without very good reason.	No additional documentation expected
Generic	Parameters that are generic values but could be changed by a user, depending on the analysis, including non-site specific parameters; generally good for the US, but if the data are available, the parameter may be made more site-specific.	User should verify applicability of input parameter with little additional documentation on technical basis expected or needed; usually review or consideration is sufficient to verify parameter applicability.
User-Defined	Parameters that should in almost all cases be evaluated by the user, including site-specific parameters. Examples are provided but these values may not be applicable to other analyses.	User should develop and document parameter value chosen for an application with a reasonable and defensible technical basis.

Abbreviated Input Parameter Application Guidance

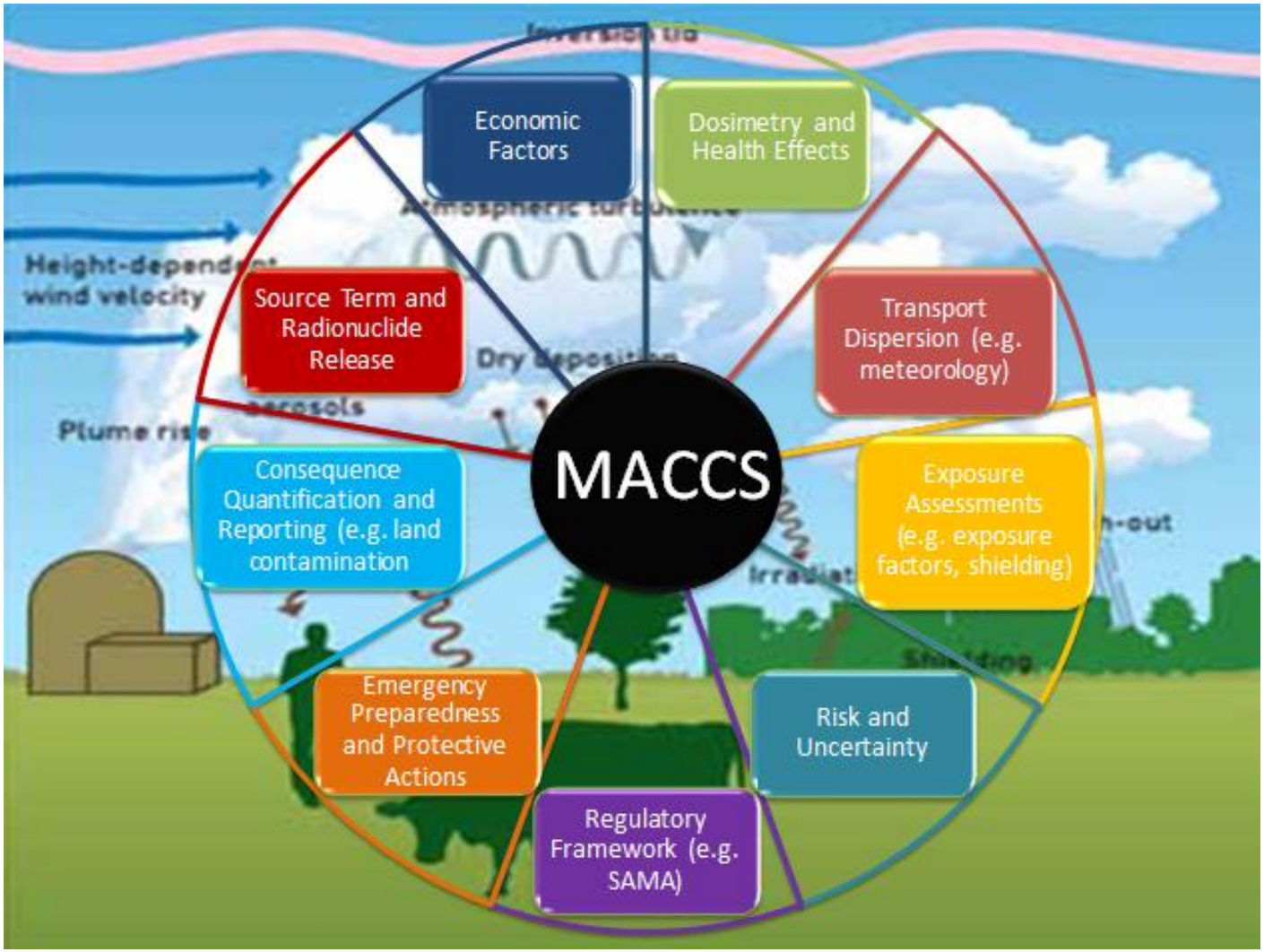
MACCS Parameter Name	Standard	Generic	User-Defined	Notes, caveats, etc.
ACNAME, 132	X			
ACTHRE, 131	X			Should only be changed when updating to different guidance, e.g., BEIR VII.
BNDMXH, 28		X	X[1]	Should be based on regional or US data, depending on size of grid.
BNDRAN, 29		X	X[1]	Boundary rain can be used beyond 500 mi.
BNDWND, 28		X	X[1]	Should be based on regional or US data, depending on size of grid.
BRGSMOD, 51		X		
BRKPNT, 44	X			
BRRATE, 68		X	X[1]	
BUILDH, 50			X	
CDFRM, 109		X[3]		
CDNFRM, 109		X[3]		
CFRISK, 132	X			Should only be changed when updating to different guidance, e.g., BEIR VII.

[1]Some analyses may require site- or analysis-specific input
[2]A number of recognized sources may be of general applicability
[3]Cost values should be escalated from base year to year of interest by the analyst

Conclusion

- Objective was to develop a comprehensive, updated summary of the technical bases for the quantification and application of MACCS input parameters
  - Provide alternative to starting with Sample Problem A values
- Because MACCS may be used for many different applications, the recommendations in the input parameter guidance report should be considered in context of the analysis being performed
- Developed recommendations for 172 MACCS input parameters
- Near-term publication as NUREG/CR following peer-review

Questions


Economic Factors
Dosimetry and Health Effects
Source Term and Radionuclide Release
Transport Dispersion (e.g. meteorology)
MACCS
Consequence Quantification and Reporting (e.g. land contamination
Exposure Assessments (e.g. exposure factors, shielding)
Emergency Preparedness and Protective Actions
Risk and Uncertainty
Regulatory Framework (e.g. SAMA)
Height-dependent wind velocity
Plume rise