Reserve Model Formulation

1. **Fundamental Sets and Indices**

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| Item | Definition |
| Generation Offers | A generation offer is represented by an element of the set OFFERS and is indexed by g |
| Reserve Offers | A reserve offer from a generator or interruptible load provider is represented by an element of the set RESERVEOFFERS and is indexed by r. Reserve offers are not class-specific. One reserve offer can provide for different reserve classes based on reserve class effective factors of the reserve offer. |
| Reserve Classes | A reserve class is represented by an element of the set RESERVECLASSES and is indexed by c. RESERVECLASSES = {Fast,Sustained,Lasting} |
| Reserve  Types | A reserve type is represented by an element of the set RESERVETYPES and is indexed by element s. RESERVETYPES = {PLSR,TWD,IL} |
| Risk Classes | A risk class is represented by an element of the set RISKCLASSES and indexed by rc. |

1. **Derived Sets**

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| Item | Definition |
| OFFERSi | is the set of all generation offers belonging to island i. |
| RESERVEOFFERSi | is the set of all reserve offers in island i. |

1. **Parameters**

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| Item | Definition |
| ReserveOfferBlocksr | The number of blocks in reserve offer r ∈ RESERVEOFFERS |
| ReserveOfferProportionr, j | The incremental MW percentage of the jth block of offer r ∈ RESERVEOFFERSPLSR. |
| ReserveOfferMaximumr, j | The maximum MW reserve available from the j th block of the reserve offer r. |
| ReserveGenerationMaximumg | The maximum MW generation and reserve capability associated with generation offer g ∈ OFFERS |
| ReserveClassFactorr, j,c  (New parameter) | Effective factor of each block j of reserve offer r for reserve class c. |
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1. **VARIABLES**

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| Item | Definition |
| GENERATIONg | The scheduled part of MW generation corresponding to offer g. |
| RESERVEr | The reserve scheduled corresponding to reserve offer r ∈ RESERVEOFFERS |
| RESERVEBLOCKr,j | The reserve scheduled corresponding to jthblock of the reserve offer r. |
| RESERVECLASSMWr,c  (New variable) | The effective factor of the reserve scheduled corresponding reserve offer r for reserve class c |
| ISLANDRISKi,c,rc | The MW risk for island i∈ISLANDS, reserve class c∈RESERVECLASSES and risk class rc∈ RISKCLASSES. The variable is unrestricted. |
| ISLANDRESERVEi,c | The effective reserve of class c∈RESERVECLASSES scheduled at island i∈ISLANDS. |

1. **EQUATIONS**

Only equations that are removed, modified or added are mentioned in the following section

1. **RISK EQUATIONS**

Equation 3.4.1.1 to 3.4.1.10 remain same as status quo with reserve class has extra element LIR (for 15 minutes reserve).

1. **RESERVE SHARING EQUATIONS**

Equation 3.4.2.1 to 3.4.2.31 remain same as status quo with reserve class has extra element LIR (for 15 minutes reserve).

1. **RESERVE EQUATIONS**

Equation 3.4.3.1 to 3.4.3.4 will be replaced by the following equations

1. PLSR reserve proportion limit (3.4.3.1)
2. Maximum reserve offer for each offer block (3.4.3.2)
3. Total cleared reserve from each offer (3.4.3.3)
4. Total cleared reserve+generation is constrained by capacity (3.4.3.4)
5. Calculate effective cleared reserve for each reserve class (New constraint)
6. **MATCHING RESERVE REQUIREMENT AND AVAIALBILITY**

The same as status quo with extra reserve class LIR (for 15 minutes)

1. Matching of reserve requirement and avaialability (3.4.4.1)
2. Calculate total island cleared reserve (3.4.4.2)