
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.: 420-8482
SRP Section: 19.03 – Beyond Design Basis External Event (APR1400)
Application Section: DCD 19.3, Ch. 8, Ch. 9
Date of RAI Issue: 02/29/2016

Question No. 19.03-37

NRC Commission paper SECY-12-0025 stated that the NRC staff expected new reactor design certification applications to address the Commission-approved Fukushima actions in their applications to the fullest extent practicable. In performing its review of the APR1400 design certification application, the NRC staff followed the guidance for satisfying the Commission directives regarding BDBEE mitigation strategies in Japan Lesson-Learned Project Directorate JLD-ISG-2012-01, Revision 0, which endorsed with clarifications the methodologies described in NEI 12-06, Revision 0. The guidance in JLD-ISG-2012-01 describes one acceptable approach for satisfying the Commission directives regarding BDBEE mitigation strategies (i.e., Order EA-12-049). TR APR1400-E-P-NR-14005-P, Rev. 0 provides details regarding mitigating strategies and design enhancements to meet Near-Term Task Force (NTTF) recommendations, NRC orders, and agency guidance related mitigation strategy during Beyond Design Basis External Events (BDBEE).

TR, APR1400-E-P-NR-14005-P, Revision 0, Section 5.1.2.6.1.2, “DC Power” states in part that the safety-related batteries that are extended for use longer than 8 hours, with reduced discharge rate through load shedding, are not required to be additionally qualified for FLEX profiles since the NRC endorsed the NEI White Paper with clarifications in September 2013 (References 10 and 11).

DCD Section 8.3.2.1.2.6, “System Capacity and Capability,” states in part that the battery is sized based on the duty cycle of the respective subsystems. Each battery is capable of supplying power to the worst-case operating loads for a period of the battery duty cycle. The sizing of the battery is performed in accordance with the IEEE Std. 485 (Reference 52). Class 1E battery loads and duty cycles are shown in the Table 8.3.2-1 and the battery rating is shown in Table 8.3.2-4. The Class 1E batteries are qualified in accordance with IEEE Std. 535.

NEI White Paper with clarifications in September 2013 (ML13241A188), TR, APR1400-E-P-NR-14005-P, Revision 0, Reference 10, states in part that the industry does not believe that the Institute of Electrical and Electronics Engineers Standard 535 (IEEE 535) is applicable to

beyond design basis events and that battery qualification for an extended loss of ac power event is not intended. NRC staff's position is that IEEE 535 is an acceptable approach for overall integrated plans (OIPs), although the alternative described in the white paper is also acceptable provided that licensees are able to demonstrate that the manufacturer discharge curves support the duty cycle duration assumed as part of the OIPs.

1. Provide analysis to demonstrate that the batteries have the capacity and capability for 8 hours and beyond based on the loading requirements for BDBEE during Phase 1 coping and beyond, or provide manufacturer discharge curves to support the duty cycle duration.

Response

As stated in the response to Question No. 19.03-31 of this RAI, the first 8 hours (Phase 1) after the onset of BDBEE, the capacities of all the Class 1E 125 Vdc batteries (trains A, B, C, and D) are sufficient to provide dc power to all essential loads necessary to perform their safety duties. The capacity and capability of the Class 1E batteries for the first 8 hours after the onset of BDBEE has already been addressed in the response to Question No. 19.03-30 & 31 of this RAI.

Furthermore, for the first 8 hours after the onset of the BDBEE and beyond (up to 40 hours with load shedding), train C and D Class 1E dc power systems are capable of supplying dc power for the operation of turbine driven auxiliary feed-water pumps (TDAFWPs), as stated in TR APR1400-E-P-NR-14005-P (Rev. 0), Section 5.1.2.3.1.1.2.

The battery sizing calculation files using IEEE 485 methodology, which are on the basis of a manufacturer's battery discharge characteristics, demonstrate the capacity and capability of the train C and D batteries for 8 hours and beyond (up to 40 hours) and are provided as the following attachments of this response:

- Attachment 1: the list of trains C and D Class 1E 125 Vdc battery loads for BDBEE coping phases (up to 40 hours);
- Attachment 2: the duty cycle diagrams of trains C and D Class 1E 125 Vdc battery loads for BDBEE coping phases (up to 40 hours);
- Attachment 3: the cell sizing worksheets per the guidance provided in IEEE Std. 485 for BDBEE coping phases (up to 40 hours).

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

Class 1E 125 Vdc Power System Loads of Train C During BDBEE

TS



Class 1E 125 Vdc Power System Loads of Train C During BDBEE (cont.)

TS

Class 1E 125 Vdc Power System Loads of Train D During BDBEE

TS

Class 1E 125 Vdc Power System Loads of Train D During BDBEE (cont.)

TS

Figure 1 - Diagrams of duty cycle for Train C during BDBEE (40 hours with Load Shedding)

TS



Figure 2 - Diagrams of duty cycle for Train D during BDBEE (40 hours with Load Shedding)

TS



Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS

A large, empty rectangular area enclosed by a red line with rounded corners, intended for the cell sizing worksheets.

Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS



Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS

A large, empty rectangular area enclosed by a red bracket-like border, intended for the worksheets mentioned in the header. The area is completely blank.

Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS

A large, empty rectangular area enclosed by a thin red line with rounded corners. This area is intended for the cell sizing worksheets mentioned in the header.

Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS

A large, empty rectangular area enclosed by a red bracket on the left and right sides, intended for the cell sizing worksheets.

Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS

A large, empty rectangular area enclosed by a red bracket on the left and right sides, intended for the cell sizing worksheets.

Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS



Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS

Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS



Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS

Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS

A large, empty rectangular area enclosed by a red bracket on the left and right sides, intended for the worksheets mentioned in the header.

Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS

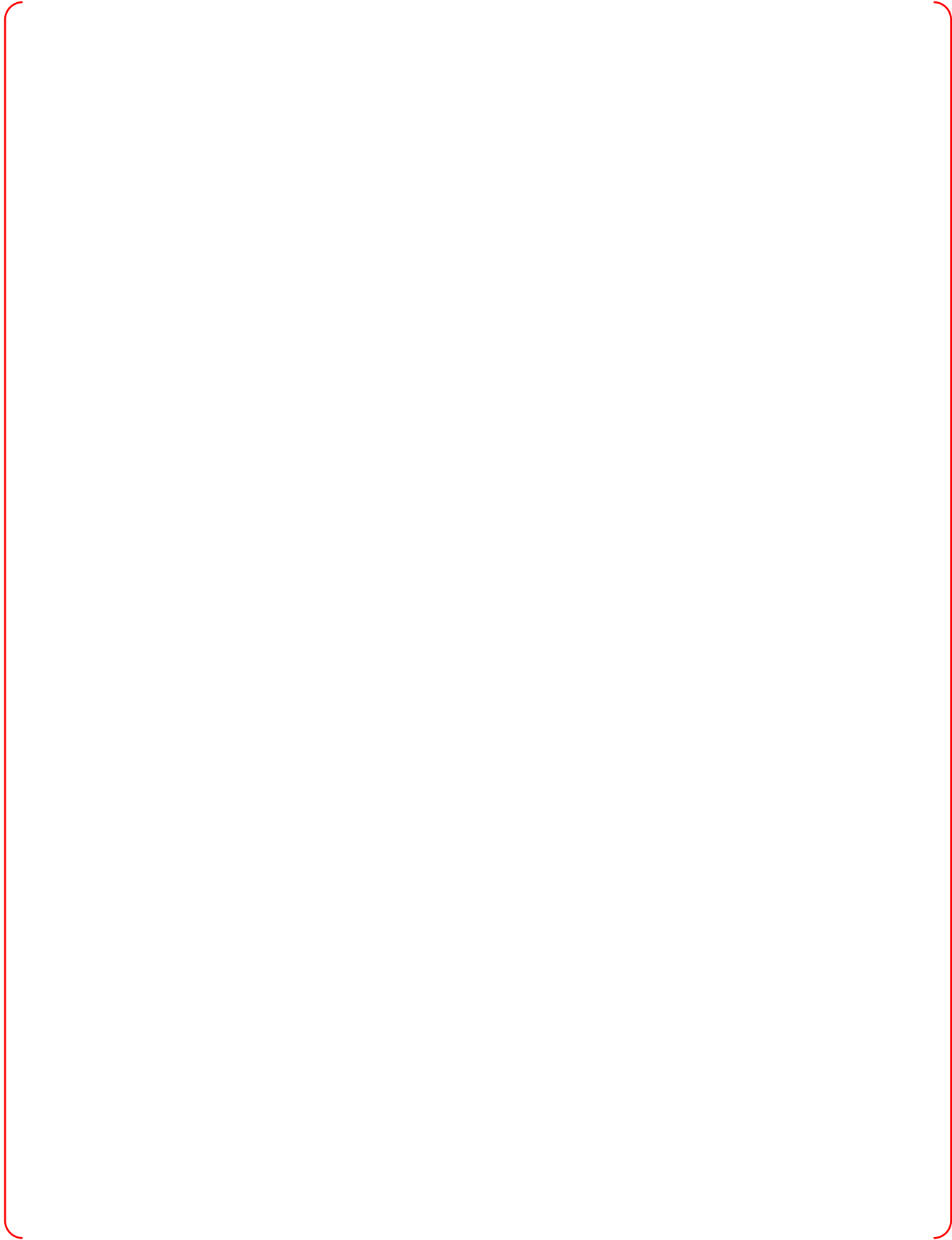


Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS

Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS



Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS

A large, empty rectangular area enclosed by a thin red border with rounded corners. This area is intended for the cell sizing worksheets mentioned in the header.

Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS

A large, empty rectangular area enclosed by a thin red line with rounded corners. This area is intended for the cell sizing worksheets mentioned in the header.

Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS

Cell Sizing Worksheets for Train C Battery during BDBEE (with Load Shedding)

TS

A large, empty rectangular area enclosed by a red bracket-like border, intended for the worksheets mentioned in the header. The area is completely blank.

Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS

A large empty rectangular area with rounded corners, enclosed by a thin red border, intended for worksheets.

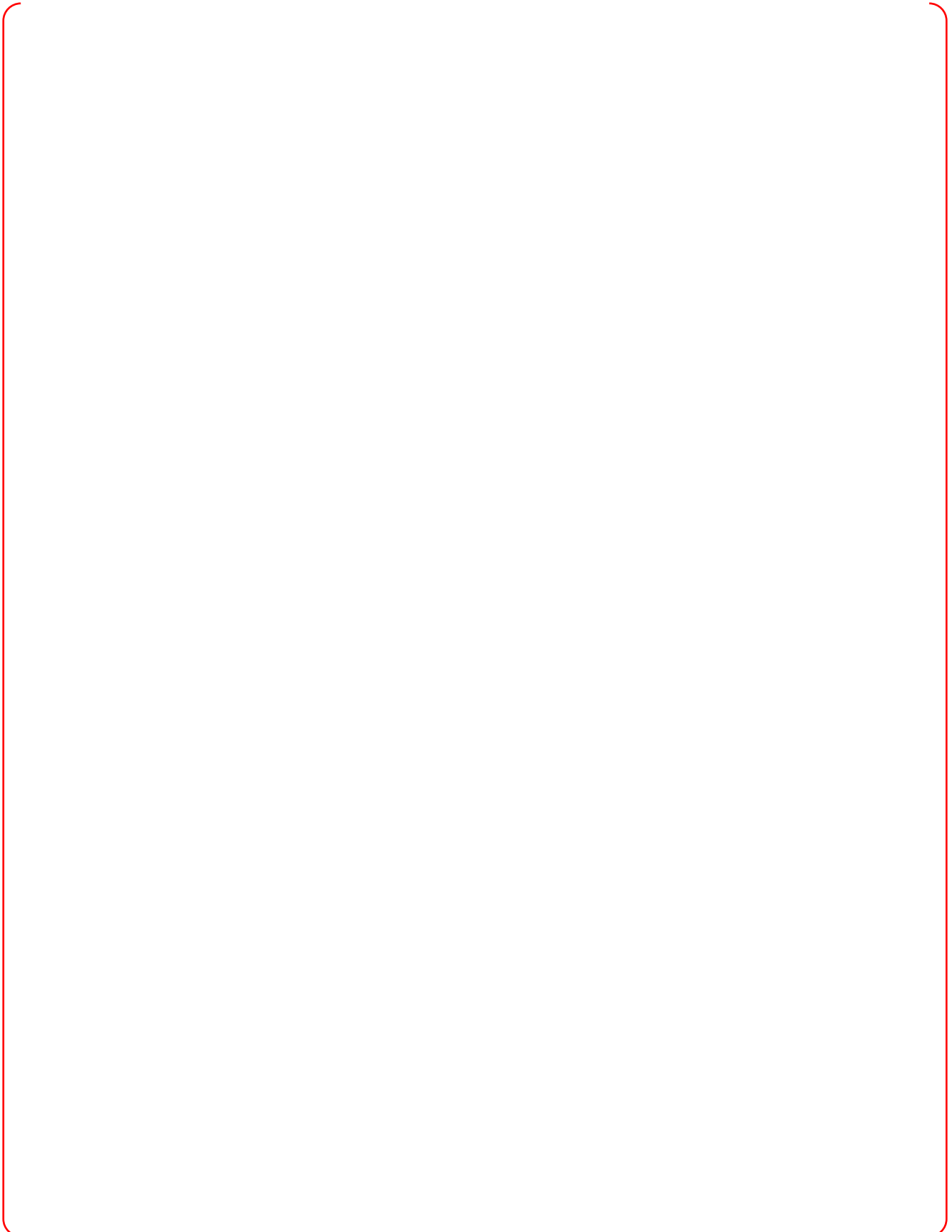
Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS



Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS



Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS

A large, empty rectangular area enclosed by a thin red line with rounded corners. This area is intended for the cell sizing worksheets mentioned in the header.

Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS

A large, empty rectangular area enclosed by a thin red line with rounded corners. This area is intended for the cell sizing worksheets mentioned in the header.

Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS

Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS



Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS



Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS



Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS

A large, empty rectangular area enclosed by a red bracket-like border, intended for the cell sizing worksheets. The area is completely blank.

Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS

Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS



Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS

A large empty rectangular area with rounded corners, enclosed by a thin red border, intended for worksheets.

Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS



Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS

A large, empty rectangular area enclosed by a red line with rounded corners, intended for the worksheets mentioned in the header.

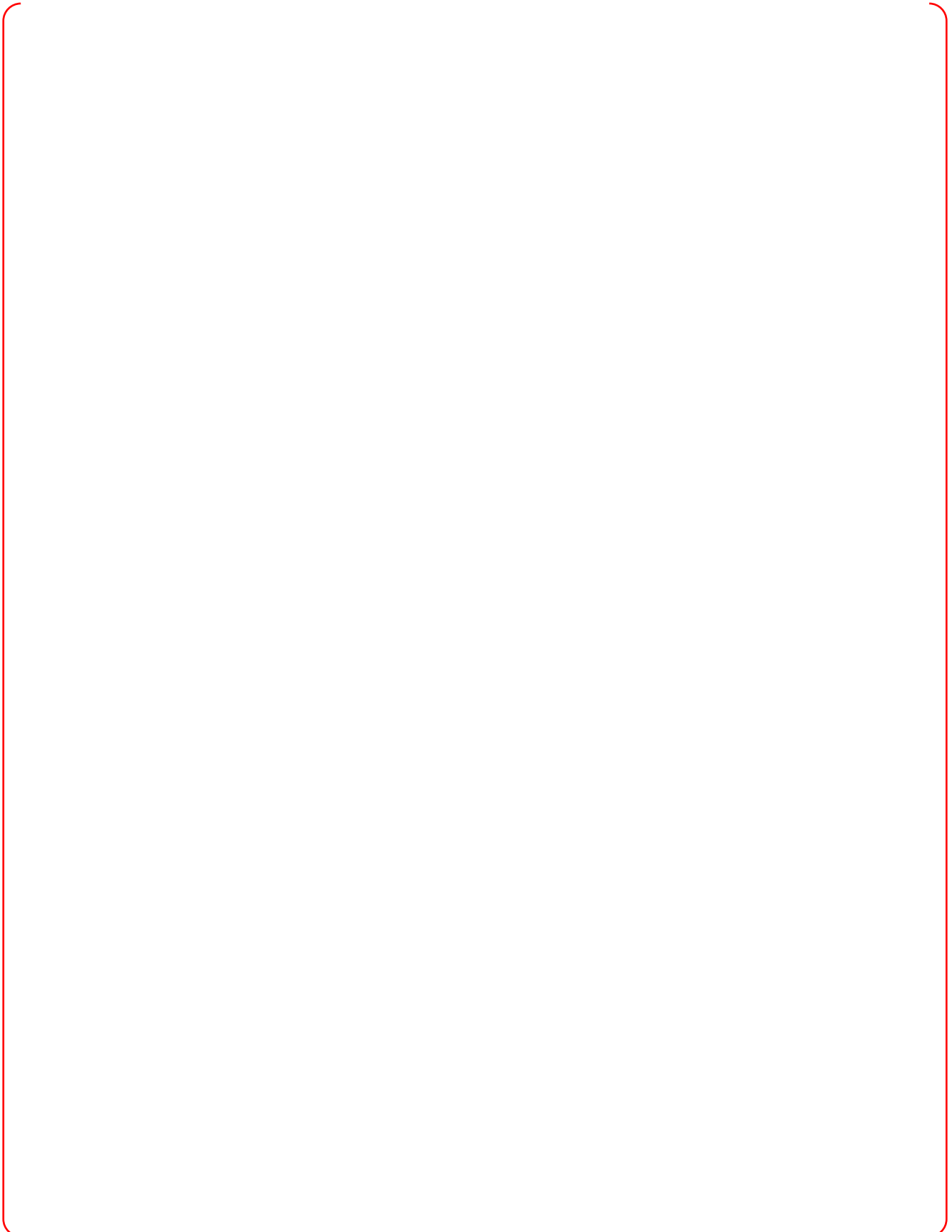
Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS

A large, empty rectangular area enclosed by a thin red border with rounded corners. This area is intended for the cell sizing worksheets mentioned in the header.

Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS



Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS

A large, empty rectangular area enclosed by a thin red line with rounded corners. This area is intended for the cell sizing worksheets mentioned in the header.

Cell Sizing Worksheets for Train D Battery during BDBEE (with Load Shedding)

TS