Virtual Dynamic Events of BAJA SAEINDIA 2023

Guidelines – Part 2

Sr.No.	Virtual Dynamic Event Name	Points
1	Maneuverability	50
2	All-Terrain Performance	100
Total points allocated for Virtual Dynamic Events		**150**

- These guidelines are an extension to the Virtual Dynamic Event Guidelines I released previously. This document covers the Virtual Dynamic Event tracks release, SOP for the submission of TestRun (after iterations ,optimization and finalization of Maneuver and IPG Driver model), and the Scoring criteria for the Virtual Dynamic Events.
- The event slotting for Virtual Dynamic Events shall be uploaded on BAJA SAEINDIA Forum ahead of the Phase-2 Event and the subsequent track attempt of the teams will be livestreamed accordingly. Teams to note that there shall be no active participation of teams required for Virtual Dynamic Events, they have to watch their attempt on livestream as per the slotting.
- All teams should use exactly the same Vehicle Model as submitted to BAJA SAEINDIA, for testing their vehicle and finalizing the Maneuver & IPG Driver. If any type of change, even of minor value is done in vehicle parameterization of the submitted model, the Virtual Dynamic Event attempt of that team might fail during simulation at our end while live streaming and the team will end up losing points. Hence, teams are strictly advised to use the same Vehicle Model as submitted to BAJA SAEINDIA.

Important Note:

1. The teams should make sure to read this document thoroughly, and if any deviations from the same are found in the submitted TestRun files, especially in the **Maneuver Commands, Maneuvers, and IPG Driver**, respective teams shall receive a penalty in their Virtual Dynamic Event score.
2. Teams must strictly use IPG CarMaker Version 11.0 only for creating the TestRun files.

A] VIRTUAL DYNAMIC EVENT TRACKS RELEASE

Virtual Dynamic Event Tracks for BAJA SAEINDIA 2023 are hereby released.

Link to download the **Virtual Dynamic Event tracks and supporting files** – https://bit.ly/BSI23-Virtual_Dynamic_Event_Tracks

A.1. PROJECT FOLDER CONFIGURATION

- The project folder submitted by the teams needs to be first configured before starting their work on the tracks.

Step 1: Download the **Virtual Dynamic Event Tracks**, **Movie** and **TeamID_TeamName_TestRun** folder from the link given above.

Step 2: Extract the Tracks folder and paste it into the teams submitted project folder inside **Data > Road** folder. Refer Fig. 1.

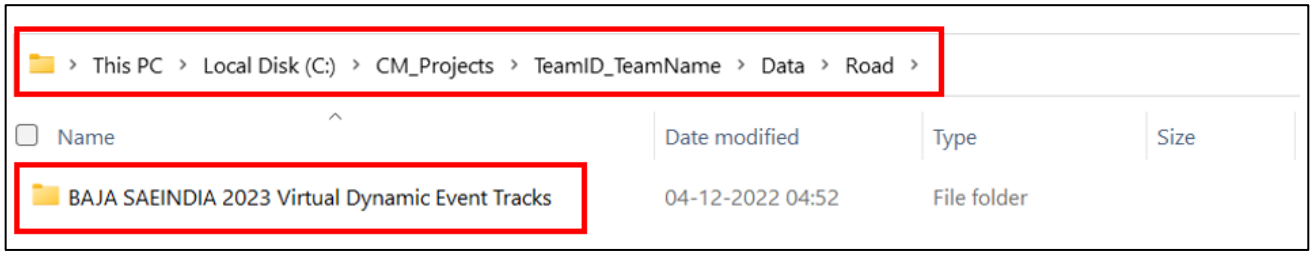


Figure 1: Path to paste the Virtual Dynamic Event Tracks Folder

Step 3: Paste the Movie Folder in **CM_Projects > TeamID_TeamName** folder. (Do not delete the already existing Movie folder or any of its contents, only paste the new contents. In Windows 10 and Windows 11, while pasting, the new Movie folder automatically merges with the existing one. Choose the option **"Replace the files in the destination"**, if the pop-up to replace or skip files is shown while pasting the Movie folder. (Care to be taken when pasting the same in other Windows versions or other OS). Refer Fig. 2.

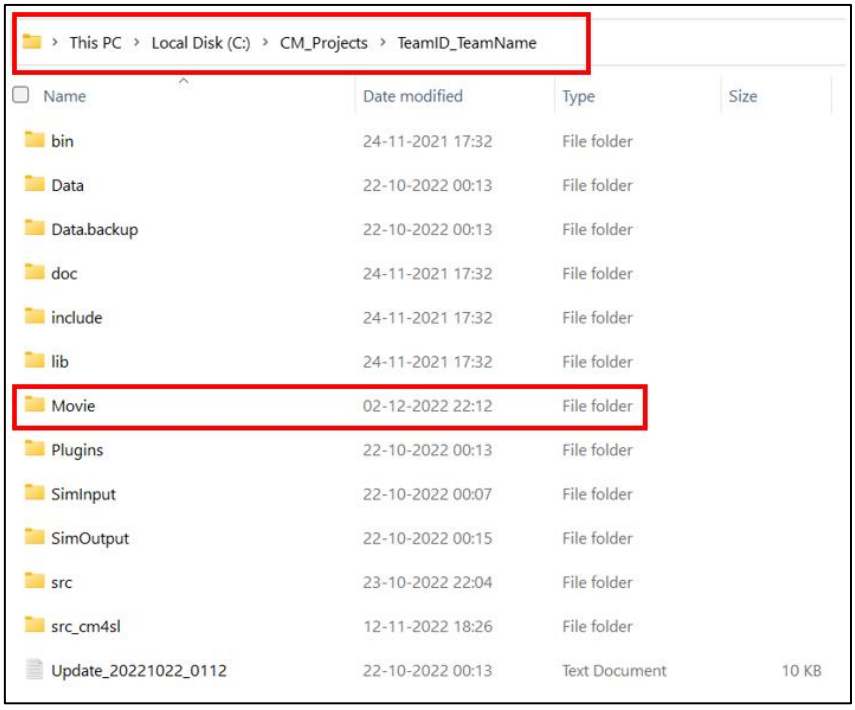


Figure 2: Path to paste the Movie Folder

Step 4: Download and extract the **TeamID_TeamName_TestRun** folder inside **Data > TestRun** folder and update the name of corresponding folders as per the Team ID and Team Name. Refer Fig. 3.

- **The TestRun file for ATP Event has been provided in the TeamID_TeamName_TestRun Folder.** (Any new TestRun file for ATP should not be created and only the given TestRun file must be edited). Refer Section C.2 for further details.
- For Maneuverability Event, teams **must** create a new TestRun with the name **TeamID_TeamName_Maneuverability** in the downloaded and extracted **TeamID_TeamName_TestRun** folder.

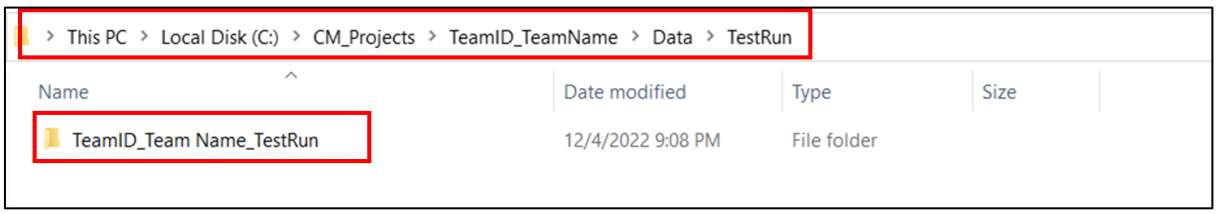


Figure 3: Path to Extract TestRun folder

A.2. ERROR HANDLING

Step 1: Open Scenario Editor, and Load the respective Virtual Dynamic Event Track file. Refer Fig. 4. (For ATP event, the appropriate Virtual Dynamic Event Track file is pre-loaded in the given TestRun, depending upon the route selection the team intends to choose Please refer Section C.2. Do **NOT** change the selection in Scenario editor for ATP Event)

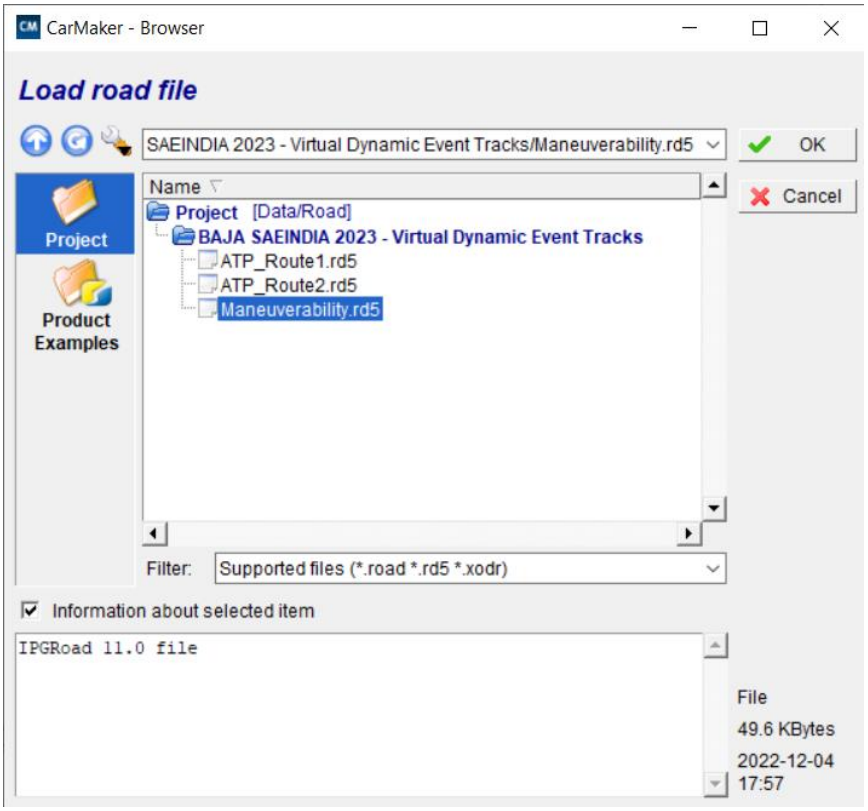


Figure 4: Loading the Virtual Dynamic Event Track file in the Scenario Editor

Step 2: Open Error Handling and change the value of General Error and Initialisation as shown in figure below. Refer Fig. 5.

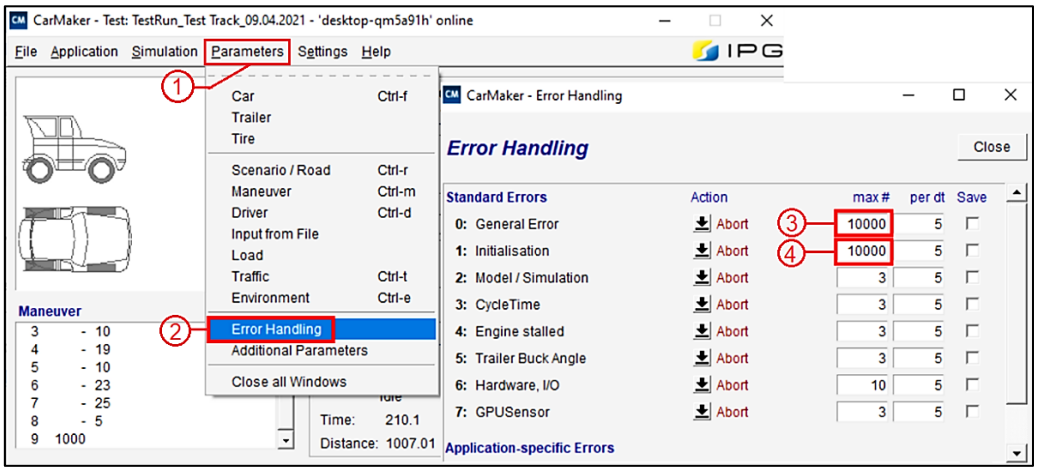


Figure 5: Configuring Error Handling

A.3. CONFIGURING MANEUVER

Step 1: Open the **Maneuver** window from the IPG CarMaker GUI after loading the Vehicle Data Set.

Step 2: Paste the **Maneuver Commands** in **Global Settings/ Preparation** as per the image below. Please note that these **Maneuver Commands** are **different for each Virtual Dynamic Event Track**. While pasting the Maneuver Commands, please note that **no changes should be made in syntax** (even an additional space given in syntax by mistake will lead to error in evaluation). Refer Fig. 6.

Link for Maneuver Commands- https://bit.ly/BAJA_SAEINDIA-2023_Virtual-Dynamic-Event_Maneuver_Commands

Step 3: Also check whether the **Start Values** are kept as **default and 0**, as per Fig. 6. Any **deviation in the Start Values** unless otherwise specified will lead to **Disqualification (DQ)**.

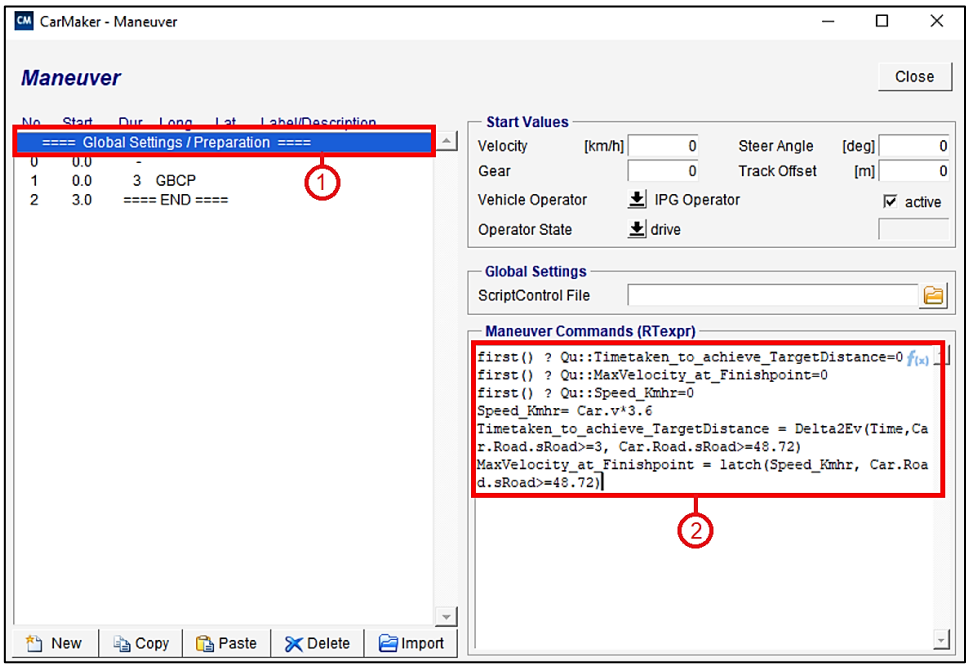


Figure 6: Maneuver Commands and Start Values

Once all the above steps are completed, try different iterations of Maneuver & IPG Driver (within the constraints of the vehicle and rulebook), for the vehicle to complete the entire track successfully, improve the lap time and bring down the track penalty counts for the same. Teams might face subsequent errors related to unsuccessful completion of track, which can be resolved by trial & error on Maneuver & IPG Driver model as discussed in the Training sessions.

Tips for Iterating Maneuvers:

After running a simulation subsequent to the Maneuver iterations, teams can review the vehicle behaviour (like driving off-course) in different sections of the track, through IPG CarMaker GUI > **Simulation > Model Check**. Refer Fig. 7.

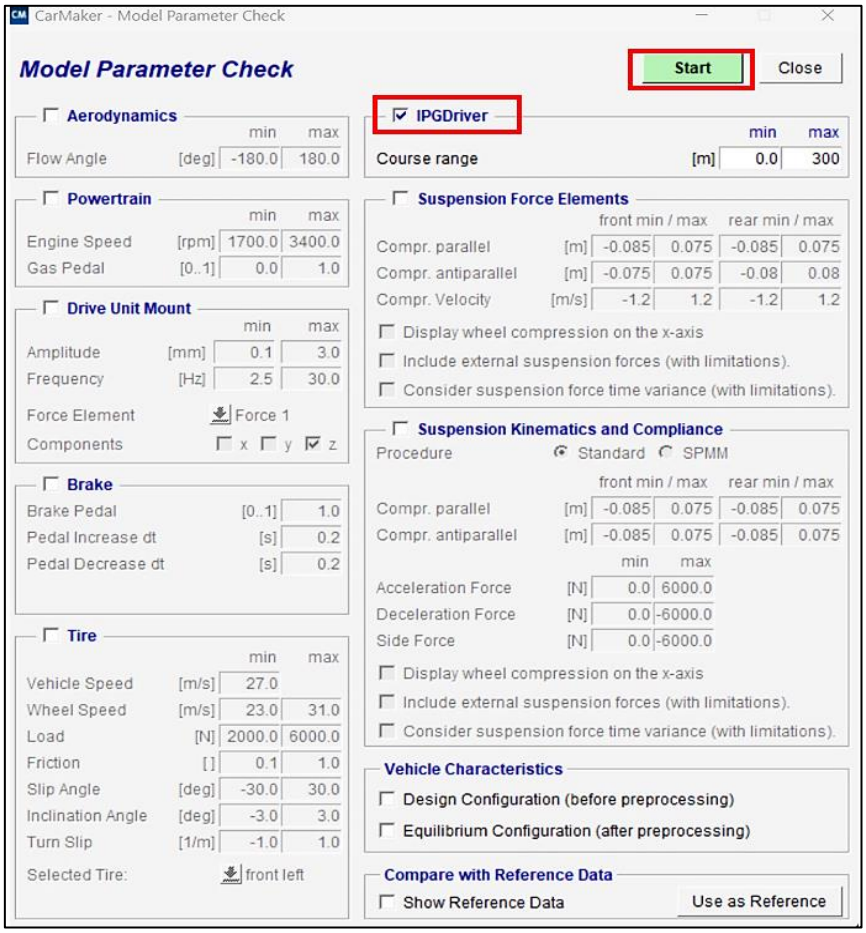


Figure 7: Configuring Model Parameter Check window for reviewing IPG Driver maneuver results after a simulation iteration

The Birds Eye View option, as shown in Fig. 8, after running the Model Check, can be specifically helpful to check if the vehicle is driving off-course excessively.

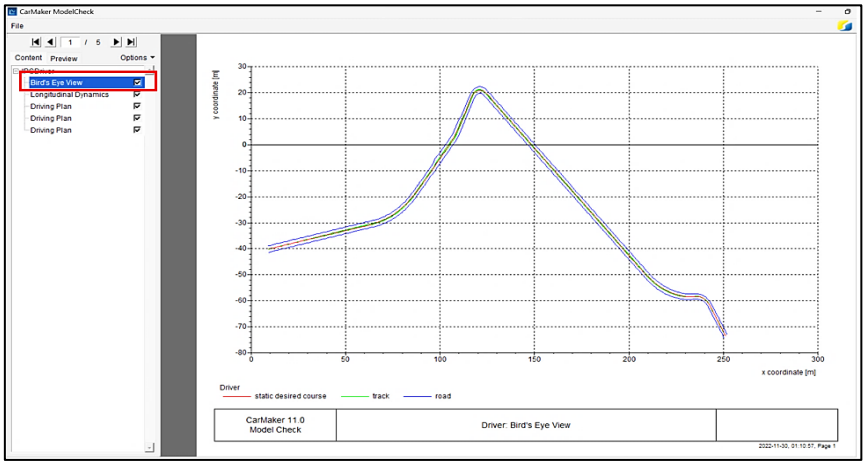


Figure 8: Birds Eye View option for checking the course deviation of the vehicle after a simulation

A.4. Direct Variable Access

Teams can check the outputs/results after trying different iterations and running subsequent simulations, through IPG CarMaker GUI > **Application > Direct Variable Access**.

Once the **Direct Variable Access (DVA)** is opened, the quantities to be checked can be loaded as per Fig. 9. Multiple quantities can be loaded in the DVA window at a time, as per the requirement. After pasting the **Maneuver Commands**, and configuring the **Maneuver**, carry out a simulation run first, before accessing the DVA quantities, because these won't be accessible until then.

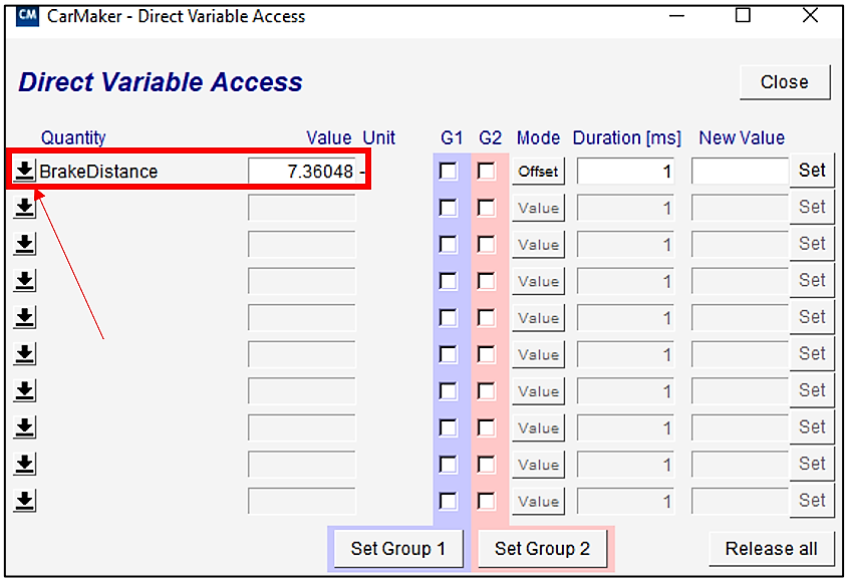


Figure 9: Configuring Direct Variable Access

The specific DVA Quantities that can be accessed for different Virtual Dynamic Events, have been stated further in this document.

Important Note:

If a team has not added a Road Sensor and Collision Sensor as mentioned in the Virtual Dynamic Event Guidelines I, they might get an error before the simulation regarding the same, and also the values of specific DVA quantities (for e.g. **Track_Offset_Count, Collision_Count, Pylon_Count, Execessive _Driving_Off_Course_Count**) will not be calculated in DVA. Hence, ensure the same before running the simulation.

B] VIRTUAL DYNAMIC EVENTS – 150 POINTS

- The Virtual Dynamic Events are intended to simulate how the teams' vehicles will perform under a variety of real-life conditions.
- Teams should note that for each Virtual Dynamic Event attempt, the time will be calculated between the **Start** and **Finish** line itself. The time taken at start for engaging of the powertrain, before the vehicle actually starts moving is not added in the output lap time. Also, after crossing the finish line the teams have to perform a braking maneuver, exactly as per stated below. The time taken to bring the vehicle to stop after crossing the finish line is also not added in the output lap time.
- The penalty criteria for each of the Virtual Dynamic Event has been given in the respective section. Penalties are times added to the total time a vehicle took to complete the course for a given run.
- The last (buffer) maneuver in each of the VDE TestRun should be as specified in the respective event sections. This maneuver is added to act as a buffer between subsequent attempts of the teams as per Virtual Dynamic Event Slotting and doesn't contribute to the result output. In case, the time taken to complete the course is greater than the event slot time, the last buffer maneuver need not be specified.

B.1. Maneuverability – 50 Points: -

Maneuver Commands : https://bit.ly/BAJA_SAEINDIA-2023_Virtual-Dynamic-Event_Maneuver_Commands

Maneuver :

- For **628 m** / until Track Finish Line, teams have to design their own maneuver/s.
- Last Maneuver - After 628 m / Track Finish Line
  Duration = **'x'** s
  Long. Dynamics > Manual (Pedals, Gear) >

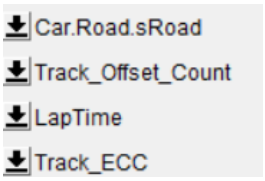
	Value	Start	dt	+/-
Clutch	1	0	0	☐
Gas	0	0	0	☐
Brake	0.5	0	0	☐

[**x** = 300 – total time taken to complete 628 m maneuver
Say for e.g., a team takes 100 sec to complete 628 m maneuver/s,
x = 300 – 100 = 200 s, will be the duration of this last maneuver]

IPG Driver :

- Cruising Speed <= 60 km/h
- Other Values in IPG Driver can be iterated by teams as per their requirement, but within the design constraints of the vehicle.

DVA Quantities :



- Note: LapTime of the vehicle is not calculated, if the vehicle fails to cross the End line.
- For such vehicles Car.Road.sRoad (Dist. Travelled by vehicle) will be used for evaluation.
- Track_ECC denotes Excessive Driving Off Course

Penalties : Pylon or Obstacle Moved – 2 seconds
1 Track Offset Count = 2 sec penalty
Excessive Driving Off Course – DNF

Scoring Criteria : *Given on pg. 13 & 14

B.2. All-Terrain Performance – 100 points: -

Maneuver Commands : https://bit.ly/BAJA_SAEINDIA-2023_Virtual-Dynamic-Event_Maneuver_Commands

Maneuver :

- For **1400 m** / until Track Finish Line teams have to design their own maneuver.
- Last Maneuver – After 1400 m / Track Finish Line
  Duration = **'x'** s
  Long. Dynamics > Manual (Pedals, Gear) >

	Value	Start	dt	+/-
Clutch	1	0	0	☐
Gas	0	0	0	☐
Brake	0.5	0	0	☐

[**x** = 480 – total time taken to complete 1400 m
Say for e.g., a team takes 100 sec complete 1400 m maneuver/s,
x = 480 – 100 = 380 s, will be the duration of the last maneuver]

IPG Driver :

- Cruising Speed <= 60 km/h
- Other Values in IPG Driver can be iterated by teams as per their requirement, but within the design constraints of the vehicle.

DVA Quantities : Car.Road.sRoad
Track_Offset_Count
LapTime
Track_ECC
Sensor.Collision.Vhcl.

- Note: LapTime of the vehicle is not calculated, if the vehicle fails to cross the end line.
- For such vehicles Car.Road.sRoad (Dist. Travelled by vehicle) will be used for evaluation.
- Track_ECC denotes Excessive Driving Off Course
- Sensor.Collision.Vhcl denotes the collision with the On-Track Vehicle

Penalties : 1 Track Offset Count = 2 sec penalty
1 Vehicle Collision Count = 5 sec penalty
Excessive Driving Off Course – DNF

Scoring Criteria : *Given on pg. 13 & 14

B.3. Track Layout

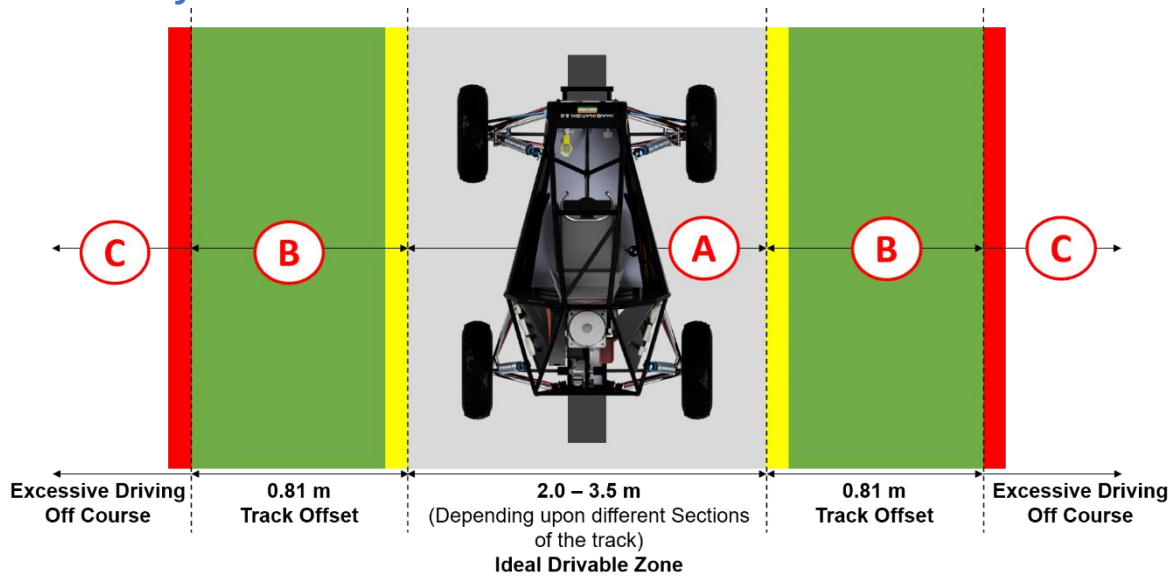


Figure 10: Virtual Dynamic Event Tracks Layout Description

The track is classified into the following 3 sections -

Section A: The track section of **width 2.0 m – 3.5 m** (Depending upon different sections of the track) **between yellow markers** is categorized as Section A. This is the main/ideal drivable zone of the track.

Section B: The track section of **width 0.81 m on both the sides of the track between the (inside lines of) red and yellow marker** is categorized as Section B. Crossing into the Yellow Line and further ahead into the green section, with one or more wheels outside Section A will lead to **Track Offset Penalty**.

Section C: The track section **beyond the (inside line of) red markers on both sides of the track** is categorized as Section C. Crossing into the Red Line and further ahead into this section of track will lead to **Excessive Driving Off Course Penalty,** which is classified as **DNF**. In this scenario, simulation may still continue probably until the finish line as well, even if the vehicle might have crossed in Section C; however, the run will still be DNF for this particular course deviation.

B.4. Track Penalties

The Organizing Committee will select penalty types imposed for different violations to account for differences in the length or design of specific event courses. Penalties are times added to the total time a vehicle took to complete the course for a given run.

Some pre-defined track penalties are as follows:

I. Pylon or Obstacle Moved

If the vehicle collides with any pylon or obstacle in the drivable zone (Section A), it shall be penalized as follows:

Pylon or Obstacle Moved – 2 seconds

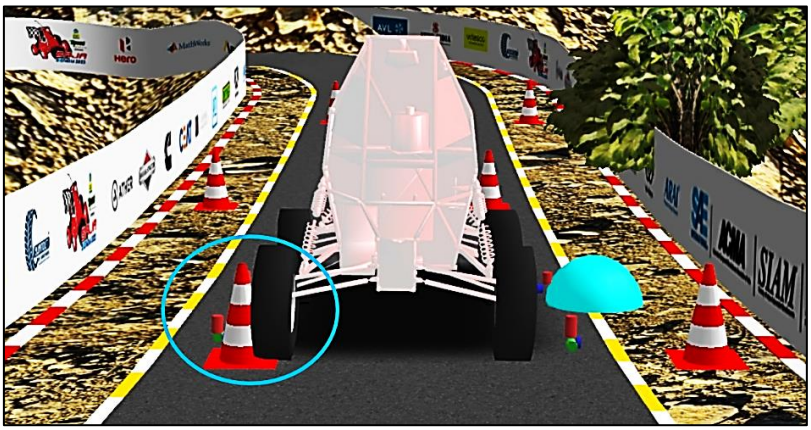


Figure 11: Representation of an on-track Pylon Moved

II. Track Offset

The Track Offset count will be logged, when one or more wheel/s of the vehicle is/are outside the drivable zone (Section A) in any specific event.

Track Offset Penalty = 2 seconds x Track Offset Count

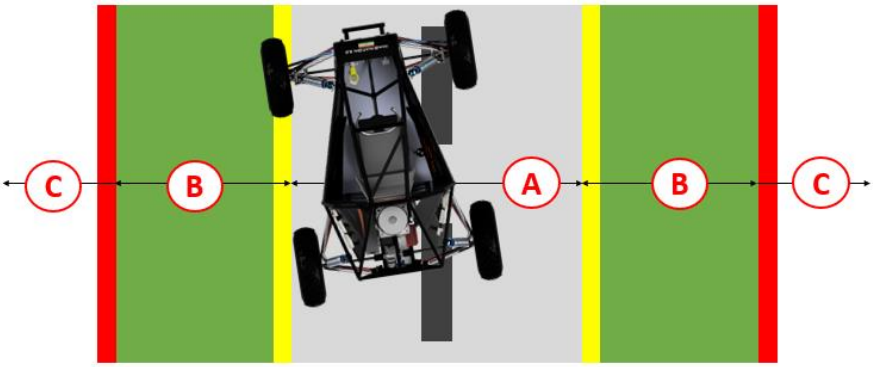


Figure 12: Representation of Track Offset Penalty Scenario

III. Vehicle Collision

Vehicle Collision Penalty will be when the team's vehicle collides with the On-track Traffic Vehicle. This penalty is only applicable for All-Terrain Performance Event.

Vehicle Collision Penalty = 5 seconds x Collision Count

Figure 13: Vehicle Collision Penalty Scenario

IV. Excessive Driving Off-Course

Case 1 - Excessive Driving Off Course is when one or more wheel/s of the vehicle is/are outside the Section A and Section B (Green Zone), that is it has crossed into the Red Line and thus, into Section C.

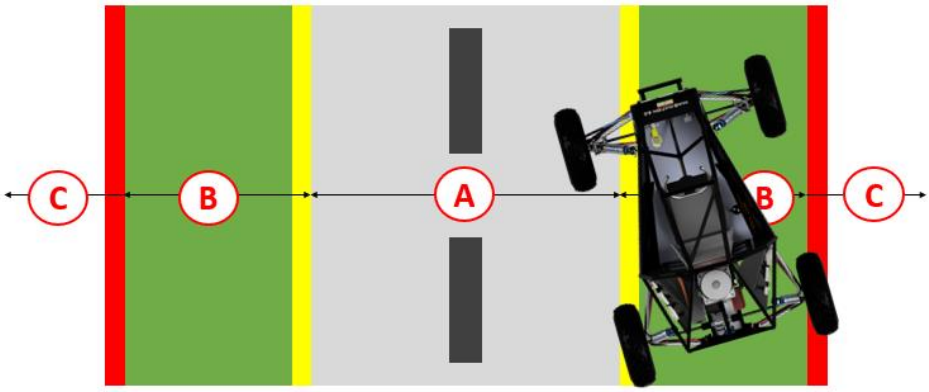


Figure 14: Representation of Excessive Driving Off Course Penalty Scenario

Case 2 - Excessive driving of course is when one or more wheel/s of the vehicle is/are outside the drivable zone (Section A) of the course over a considerable distance. The distance is discretionary and will be determined by the Virtual Dynamic Event Judge/Organizing Committee.

Excessive Driving Off Course (as per any of these 2 cases) will be classified as Run DNF (Did Not Finish).

V. False Start

False Start is when the Vehicle does not cross the Start Line within 10 seconds, after the simulation is initiated.

False Start will be classified as Run DNS (Did Not Start).

If a team is classified as Run DNF or DNS, it will mean that the team will not receive a score for that particular Virtual Dynamic Event.

B.5. Scoring Criteria for Virtual Dynamic Events

Scoring will be based on the Virtual Dynamic Event attempt of the team, as per the submitted IPG CarMaker Vehicle Model & TestRun files. If a vehicle cannot complete the course and get a lap time, it will be scored on the distance that it travels before stopping. Once the vehicle stops moving forward, the attempt is over and attempt is scored for distance at that point. All the Virtual Dynamic Events will consist of a single lap only.

For Maneuverability Event, 'P' will be replaced by '50' for score calculation.

For All-Terrain Performance Event, 'P' will be replaced by '100' for score calculation.

Method 1 (Different Distances): -

If none of the vehicles are able to complete the course, then: The following equation will be used for the scoring (S):

$$S = P \times \frac{d_{run} - d_{min}}{d_{max} - d_{min}}$$

Where:

d_{min} is the shortest distance by any vehicle.

d_{run} is the distance travelled for the vehicle to be scored.

d_{max} is the longest distance by any vehicle.

Method 2 (Fixed Distance, All Succeed): -

If there is (a) a set maximum distance and (b) all teams succeed in completing the full track, then the score will be based on the lap time for the full distance.
The following equation will be used for the scoring (S1):

$$S_1 = P \times \frac{t_{max} - t_{run}}{t_{max} - t_{min}}$$

Where:
t_{min} is the lowest (fastest) time by any vehicle.
t_{run} is the time recorded for a vehicle's run to be scored.
t_{max} is the minimum of the following:

- The longest (slowest) time by any vehicle, or
- 2.5 times t_{min}

Method 3 (Fixed Distance, Some Succeed): -

If there is (a) a set maximum distance and (b) at least one team completes the track and others do not, then the vehicles going the full distance (Group 1) will be scored based on time and the vehicles that fail to complete the track (Group 2) will be scored based on distance.

Group 1:
Where:
t_{min} is the lowest (fastest) time by any vehicle
t_{run} is the time recorded for a vehicle's run to be scored.

$$S_1 = P \times \frac{t_{min}}{t_{run}}$$

Group 2:

$$S_2 = \min(S_1) \times \frac{d_{run}}{d_{course}}$$

Where:
d_{run} is the distance recorded for a vehicle to be scored.
d_{course} is full length of the course to be run by the vehicle.

B.6. Virtual Technical Inspection

The inspection will determine if the vehicle satisfies the requirements and restrictions of the BAJA SAEINDIA® rules and IPG CarMaker Guidelines.

Virtual Technical Inspection will consist of two (2) separate stages –

1. IPG CarMaker Vehicle Model Check with respect to IPG CarMaker Guideline Restrictions.
2. IPG CarMaker Vehicle Model Check with respect to Vehicle Specification Sheet parameters.

If any vehicle is found to be in deviation of any of the above, they shall be penalized. The Virtual TI penalty shall be applicable to both the Virtual Dynamic Event scores individually.

Kindly refer to **Part C – Virtual Technical Inspection**, from Virtual Dynamic Event Guidelines I, for more information.

Note: *If there is a case where a team deviates with respect to all the evaluated parameters from guideline as well as Vehicle Specification Sheet, and their Virtual Dynamic Event penalty is more than the total event score itself, then their score shall be considered as '0'.*

B.6.1 IPG CarMaker Vehicle Model Check with respect to IPG CarMaker Guideline Restrictions

$$Guideline\ Parameter\ Penalty = Max.\ Event\ Points \times \frac{Count(No.\ of\ parameters\ deviated)}{No.\ of\ Parameters\ restricted\ in\ IPG\ CM\ Guidelines}$$

Where:

Max. Event Points = '50' for Maneuverability & '100' for All-Terrain Performance

B.6.2 IPG CarMaker Vehicle Model Check with respect to Vehicle Specification Sheet parameters

$$Spec.\ Sheet\ Parameter\ Penalty = (20\%\ of\ Max.\ Event\ Points) \times \frac{Count(No.\ of\ parameters\ deviated)}{No.\ of\ relevant\ Spec.\ Sheet\ Parameters\ to\ be\ evaluated}$$

Where:

Max. Event Points = '50' for Maneuverability & '100' for All-Terrain Performance

C] SOP for IPG CarMaker TestRun file submission

Teams have time until **7th Dec-2022, 23:59 Hrs IST** for testing their vehicle as many times on each track for **finalizing** the **Maneuver &** subsequent **IPG Driver** Model, different for each Virtual Dynamic Event track.

Step 1: Once the Maneuver & IPG Driver is finalized for a particular Virtual Dynamic Event, **Save and name** the ***TestRun file*** as **'TeamID_TeamName_VirtualDynamicEvent Name'**.

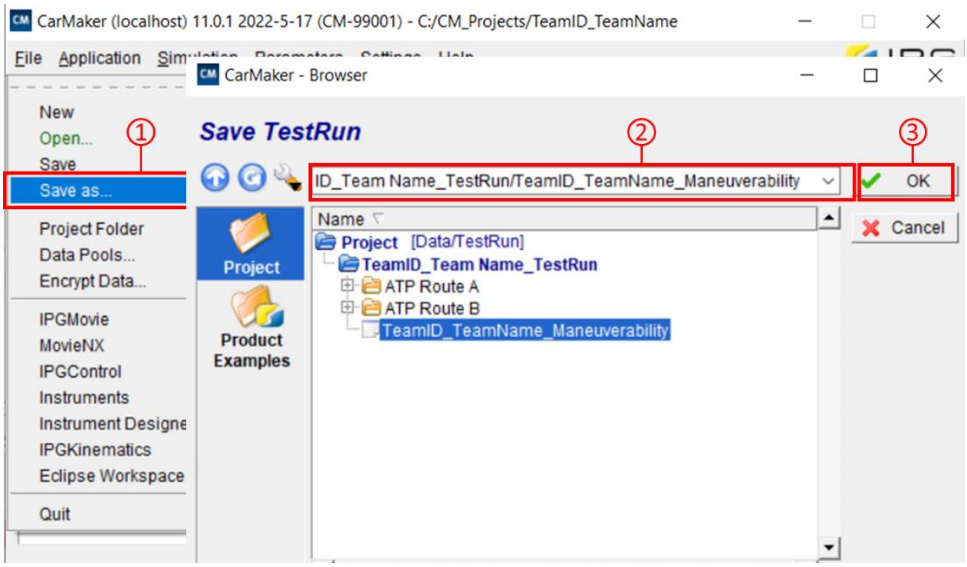


Figure 15: Saving the Virtual Dynamic Event TestRun file

Step 2: After saving and naming the TestRun file, open and load the file to review whether the ***Maneuver***, ***IPG Driver Model*** & the selected ***Road File*** from Scenario Editor is correct for that Virtual Dynamic Event's TestRun file for final submission.

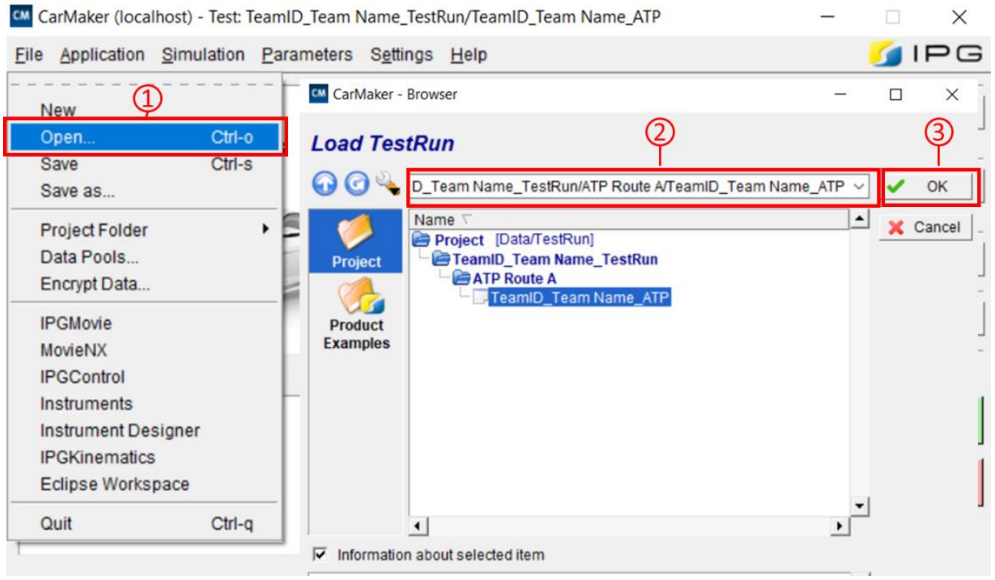


Figure 16: Loading the TestRun file for review

Step 3: Browse the **TestRun** folder in the "Data" folder. Create a **.zip** archive file of the **TeamID_TeamName_TestRun** folder which includes only two test runs of respective Virtual Dynamic Events.

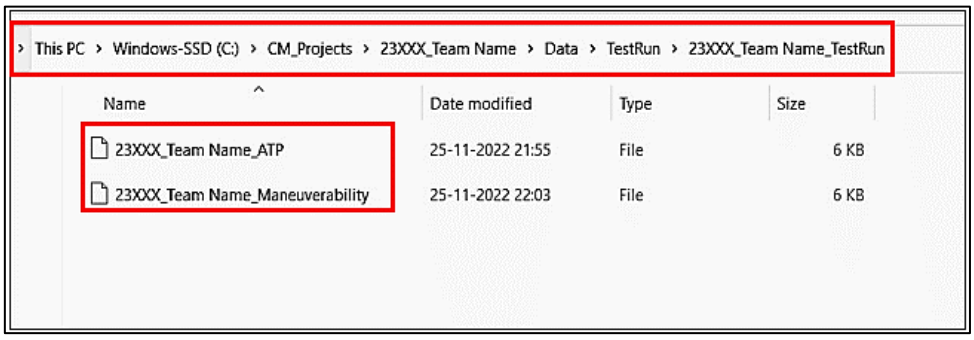


Figure 17: Path to the TestRun folder, for creating a .zip archive for uploading

Step 4: Upload the **TeamID_Team Name_TestRun.zip** in the TestRun Submission section on the BAJA SAEINDIA website before the deadline, which is **7th Dec-2022, 23:59 Hrs IST.**

Figure 18: Uploading the zipped TestRun folder on the BAJA SAEINDIA website

Step 5: In the comments field, enter the PC Configuration of the system in which the TestRun was created and reviewed in at the time of final submission.

For Intel System, enter as **PC Configuration: Intel-Based System**

For Ryzen System, enter as **PC Configuration: Ryzen-Based System**

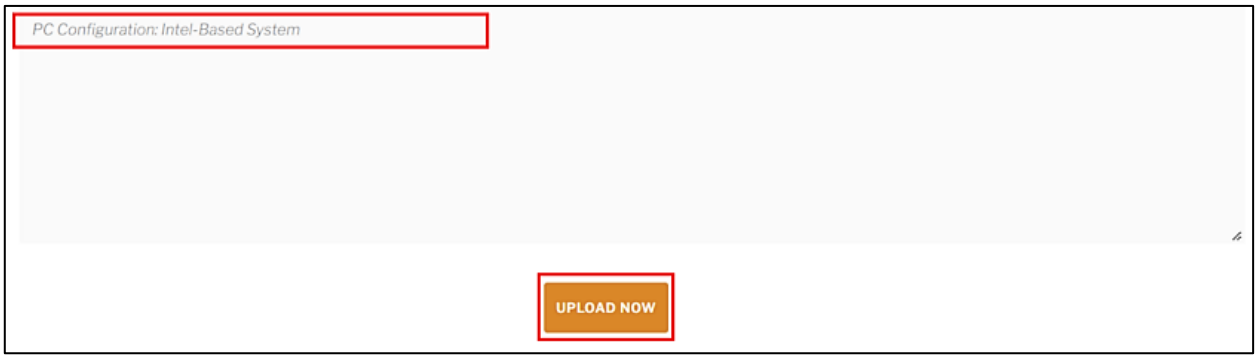


Figure 19: Mandatory Uploading the PC Configuration data

C.1. Configuring TestRun file for the Maneuverability Event

- Teams need to create and save the TestRun file for the Maneuverability Event, as per the Step 1 given above.

C.2. Configuring TestRun file for the All-Terrain Performance Event

- The All-Terrain Performance Event Track, consists of **two drive courses** -
  - **Long Course A –** Mud Crawl (Hurdles – Mud Pool and Rock Crawl)
  - **Short Course B –** Hill Climb with undulations
- Teams have been provided two TestRun files with Course A & B respectively, to choose from, for the All-Terrain Performance Event.
- The teams have to finalize any one TestRun file for a particular course, depending upon their iterations on both the courses, for the All-Terrain Performance Event. After finalizing it, delete the TestRun folder – "ATP Route X" of the **unchosen** course from the folder (Refer figure 19 below, where Long Course A is the chosen course). In case it is found that a team has inaccurately submitted the TestRun files for both the courses, the TestRun file for Course A will be considered as teams' default submission for All-Terrain Performance Event.

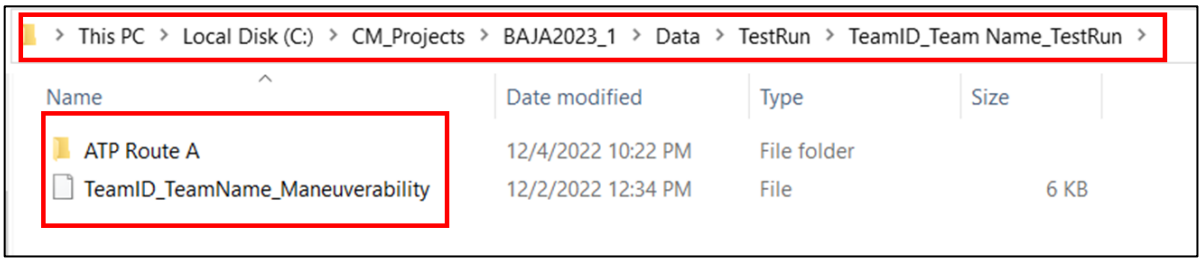


Figure 19: Only one ATP course must be present prior to final submission

- The TestRun file consists of Maneuvers for a traffic vehicle, which the teams must not edit. If any deviation is found in this regard, the team shall be penalized. Traffic Vehicle is an on-track vehicle which has been placed in two zones of the All-Terrain Performance Track, and the teams have to maneuver in these specified zones such that they do not collide with this traffic vehicle which will lead to a time penalty as specified in Section B.4 above.
- In accordance to the **chosen drive course,** the teams must paste the **Maneuver Commands in Global Settings/ Preparation,** as per Section A.3 above.
- Teams must try different iterations of Maneuver & IPG Driver for the chosen route and save the TestRun file

Sr.No.	Virtual Dynamic Event Name	*TestRun* File Name
1	Maneuverability	TeamID_TeamName_Maneuverability
2	All-Terrain Performance	TeamID_TeamName_ATP

Sr.No.	Description	Link
1	Virtual Dynamic Event Tracks	https://bit.ly/BSI23-Virtual_Dynamic_Event_Tracks
2	Maneuver Commands	https://bit.ly/BAJA_SAEINDIA-2023_Virtual-Dynamic-Event_Maneuver_Commands

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