

# EPRI's AI Planning Assistant

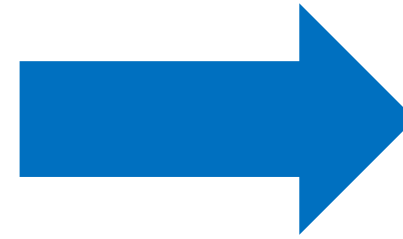
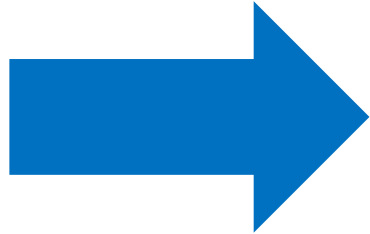
Building a Prototype Agentic Artificial Intelligence  
Platform for Transmission Planning

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# Calculators: Numbers in, numbers out

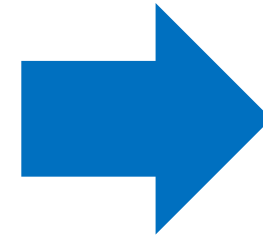
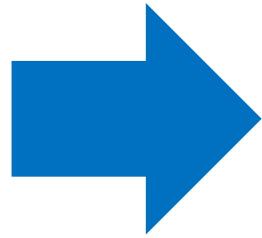
2+2



4

# LLMs: Media in, media out

Text  
Images  
Audio  
Video



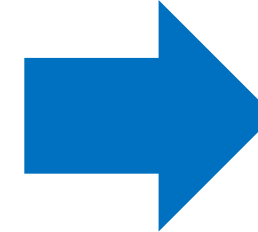
Text  
Images  
Audio  
Video



- Engineering concepts, equations, standards
- Local documents
- Tools
- Memory

# EPRI AI Grid Planning Assistant: Objectives in, Solutions Out

EPRI AI Planning Assistant



Solutions:  
Data, Charts  
Reports  
Conclusions  
Solutions



- Engineering concepts, equations, standards
- Local documents, guides, reports
- Grid Models, forecasts, restrictions
- Tools
- Memory

Objectives:  
Description  
of what you  
want

# EPRI AI Planning Assistant

This is what the existing tool looks like in your web browser

The screenshot shows the EPRI AI Protection Assistant Beta web interface. At the top left, there is a 'Dark Mode' toggle. Below it, the title 'EPRI AI Protection Assistant Beta' and version '2025.03' are displayed. A back arrow is visible. A prominent blue 'New Chat' button is centered. The 'Settings' section on the left includes: 'LLM Model:' set to 'Claude 3.5 Sonnet', 'Simulation Tool:' set to 'ASPEN OneLiner', 'Debug Level:' with a slider between 'Normal' and 'Verbose!' and an 'Off' option, and 'Temperature:' with a slider set to '0'. The 'Max Context Length:' is partially visible. At the bottom, there is a text input field containing 'Load the', a 'Copy' button, and a 'Send' button. A small input field at the very bottom says 'Type your message here'.

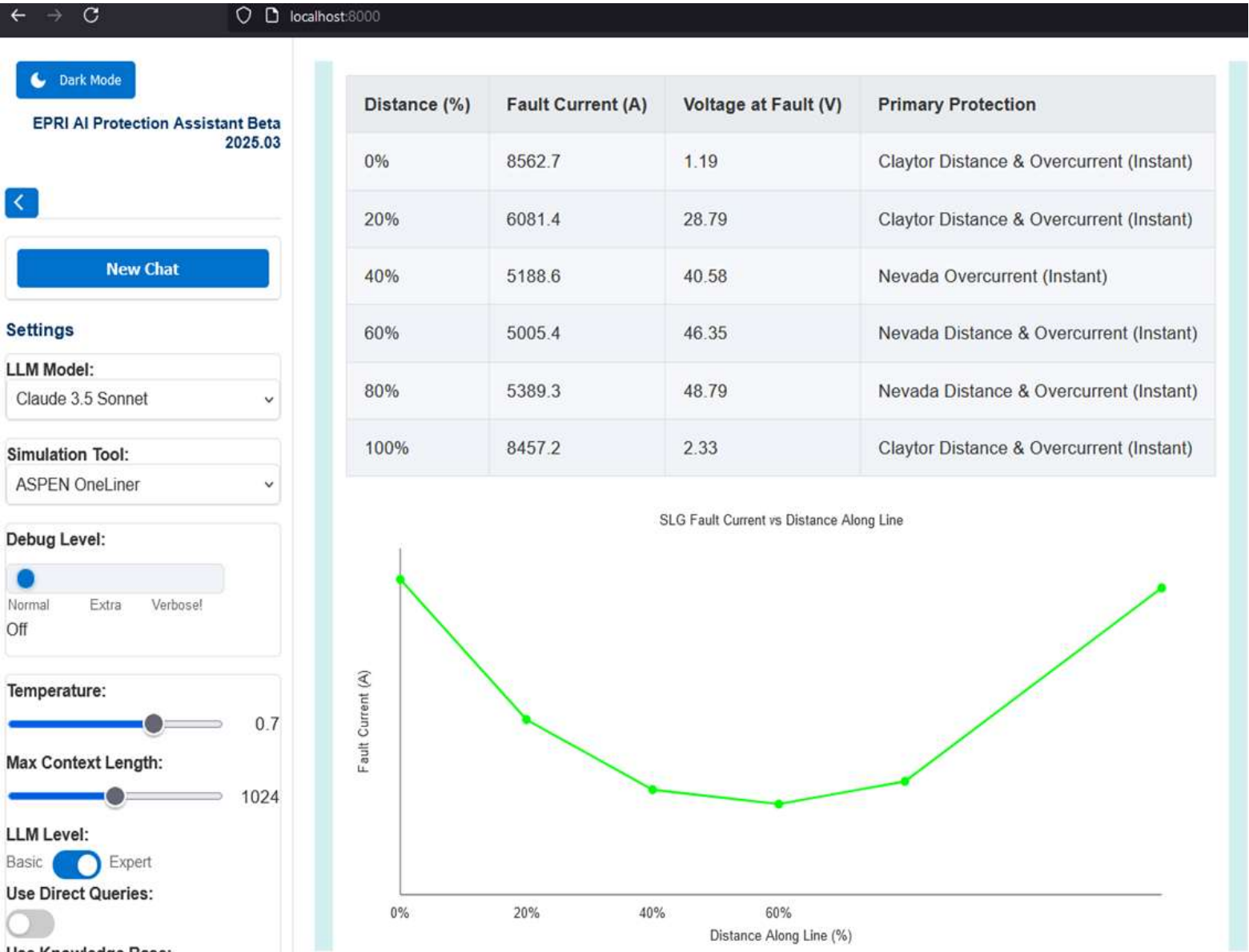
## Works with

- ✓ **Cloud-based LLMs** (ChatGPT etc)
- ✓ **On-premises LLMs** (Llama etc)
- ✓ **Local LLMs** (localLlama etc)

## Customization:

- Easily integrate your own python scripts
- Custom study and report templates
- Interact with many grid models
- Interpolate/extrapolate forecast data

# What does it look like?



## Works with

- ✓ Cloud-based LLMs (ChatGPT etc)
- ✓ On-premises LLMs (Llama etc)
- ✓ Local LLMs (localLlama)

## Customization:

- Easily integrate your own python scripts
- Enable the LLM to run them as-required



# Simulation Results

## What does the tool allow the LLM to create?

### Create PDFs

#### Breaker Duty Rating and CT Saturation Analysis - Bus 4 (132kV)

##### 1. Introduction

Breaker duty rating analysis and CT saturation studies are crucial aspects of power system protection engineering that ensure the safe and reliable operation of electrical infrastructure. Circuit breaker duty rating analysis is essential to verify that circuit breakers can safely interrupt fault currents without failure or damage. This analysis considers both the magnitude of the fault current and the rate-of-rise of recovery voltage (RRRV) that the breaker must withstand. The study ensures compliance with IEEE C37.010 standards, which provide guidelines for application and ratings of high-voltage circuit breakers.

CT saturation analysis, on the other hand, is vital for ensuring the reliability of the protection system. Current transformers (CTs) are critical components that provide accurate current measurements for protective relays. During fault conditions, high current magnitudes can cause CT core saturation, leading to distorted secondary current output. This distortion can potentially compromise the operation of protective relays, leading to delayed or missed fault detection. The analysis considers factors such as CT ratio, accuracy class, burden (including secondary wiring and connected devices), and the maximum fault current levels.

The interaction between breaker duty and CT performance is particularly important because protective relays rely on accurate current measurement to make tripping decisions. If a CT saturates during a fault, it may not properly represent the primary current, potentially leading to delayed breaker operation. This delay could expose the breaker to fault currents for longer duration, potentially exceeding its interrupting capability.

In modern power systems, with increasing fault levels due to grid expansion and interconnection, these studies have become more critical. The advent of microprocessor-based relays has somewhat mitigated CT saturation concerns through advanced algorithms, but the fundamental importance of proper CT selection and application remains unchanged. This is especially true in applications where high-speed protection is required or where fault currents approach breaker ratings.

##### 2. Scope of Work

This study focuses on the 132kV Bus 4, analyzing both breaker duty ratings and CT saturation risks. The analysis encompasses:

- Fault current calculations for three-phase and single-line-to-ground faults
- Evaluation of a 25kA SF6 single-cycle breaker's capability

### Create HTML-based Reports

#### Fault Current Summary Report

##### Single Line-to-Ground (SLG) Fault Analysis Summary

This report summarizes the results of SLG fault simulations performed on various 132 kV buses in the power system. The analysis includes fault currents, bus voltages during fault conditions, and relay operations.

Below is a comprehensive summary table of the fault currents for each bus:

Table 1: SLG Fault Current Summary

Bus Number	Bus Name	Voltage (kV)	Fault Current (A)	Fault Angle (degrees)	Fastest Relay Operation (s)	Operating Relay
8	REUSENS	132	5569.1	-83.7	0.0	[OC RELAY] NV-P1 & NV-G1
5	FIELDALE	132	7183.7	-85.7	0.089	[OC RELAY] XFMR Nevada
7	OHIO	132	4668.6	-78.4	0.087	[OC RELAY] XFMR Nevada

##### Analysis of Results

###### 1. Fault Current Levels:

- The highest fault current was observed at FIELDALE bus (7183.7 A)
- The lowest fault current was observed at OHIO bus (4668.6 A)
- All fault currents are within typical ranges for 132 kV systems

### Create CSV, XML, JSON, TXT

Apply SLG faults on every 132 kV busbar and after each simulation append the simulation results in CSV style to a report. The CSV should have one row per simulation and contain the three-phase voltages and currents and magnitudes and angles.

I'll help you create a report with SLG fault simulation results for all 132 kV busbars. I'll break this down into steps:

1. First, I'll get all busbars at 132 kV
2. Then I'll run SLG fault simulations on each bus
3. Create a report and append the results in CSV format

Let's start:

Now, let's create a report to store our results:

Let's add an introduction and header for our CSV data:

Now, for each 132 kV bus, I'll simulate an SLG fault and append the results. For bus number 2:

```
Calling tool: do with parameters: {
  "type": "simulate_fault",
  "fault_type": "SLG",
  "fault_bus_number": 2
}
```

#	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Bus Num	Bus Name	Fault Type	Va Magnit	Va Angle	Vb Magnit	Vb Angle	Vc Magnit	Vc Angle	Ia Magnit	Ia Angle	Ib Magnit	Ib Angle	Ic Magnit	Ic Angle
2	2	NORTH	SLG	0.05	-85	1.12	-125	1.15	115	12.5	-85	0.2	-170	0.2	
3	2	NORTH	3PH	0.02	-90	0.02	-210	0.02	30	15.8	-90	15.8	-210	15.8	
4	3	SOUTH	SLG	0.04	-82	1.15	-122	1.14	118	11.8	-82	0.15	-165	0.15	
5	3	SOUTH	3PH	0.02	-90	0.02	-210	0.02	30	14.9	-90	14.9	-210	14.9	
6	4	EAST	SLG	0.03	-88	1.13	-128	1.16	112	13.2	-88	0.18	-172	0.18	
7	4	EAST	3PH	0.02	-90	0.02	-210	0.02	30	16.2	-90	16.2	-210	16.2	
8	5	WEST	SLG	0.06	-83	1.14	-123	1.13	117	12.1	-83	0.22	-168	0.22	
9	5	WEST	3PH	0.02	-90	0.02	-210	0.02	30	15.5	-90	15.5	-210	15.5	
10	6	CENTRAL	SLG	0.04	-86	1.15	-126	1.15	114	12.9	-86	0.19	-171	0.19	
11	6	CENTRAL	3PH	0.02	-90	0.02	-210	0.02	30	16	-90	16	-210	16	
12	26	REMOTE	SLG	0.05	-84	1.12	-124	1.14	116	11.5	-84	0.21	-169	0.21	
13	26	REMOTE	3PH	0.02	-90	0.02	-210	0.02	30	14.5	-90	14.5	-210	14.5	

# Outcome: Convert your plans into actions

Dark Mode

AI Protection Assistant Beta 2025.03

Settings

LLM Model: Claude 3.7 Sonnet

Simulation: ASPES OneLiner

Temperature: 0.7

System: Targeted protection understanding all technical terms. Responses are short and to the point.

Projects: All Projects

+ Create New Project

Sessions: UI testing 3

Test fault simulations 1

Processing Your Request

Perform a study on the 400 kV line between Bus 1004 and Bus 1005. Check protection coordination and trip time assuming a maximum primary fault clearance time of 80ms and a coordination time margin of 200ms. Check fault level against circuit breaker ratings.

Create a report with

- 1) introduction

- 2) a summary of the grid nearby including generators and large customer loads,
- 3) a summary of the protection relays, protection comms, and instrument transformers on the studied line,
- 4) a summary of protection performance and fault clearance time margin, and fault current magnitude for every fault

I've created a comprehensive report analyzing the protection scheme for the 400 kV line between Bus 1004 and Bus 1005. The report is structured as follows:

1. The current Zone 2 time delay of 60ms exceeds the required coordination margin of 200ms and should be reviewed.
2. There appears to be a discrepancy in CT ratios between different relay types that should be investigated.
3. The protection scheme includes both distance and overcurrent elements providing redundancy.
4. Zone 1 reach appears appropriate at approximately 80% of the line length.

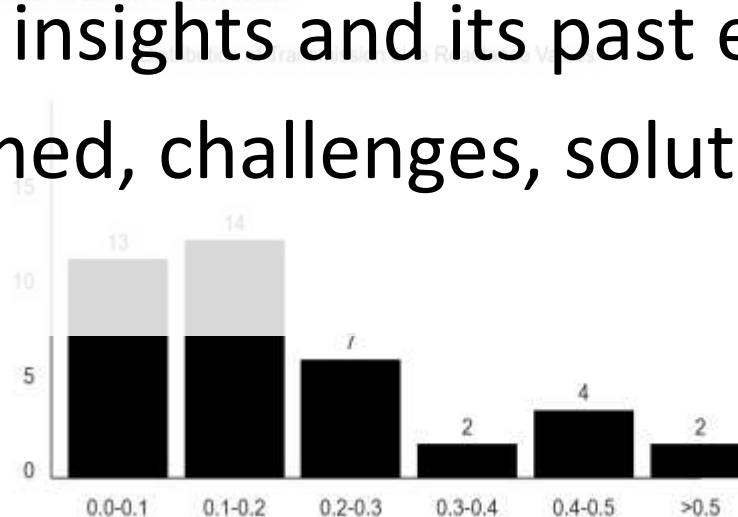
Type your message here...

Send

SLG Fault Current vs Distance Along Line



Let me visualize this distribution with an SVG bar chart



- ✓ Work with the AI to define study objectives and approach
- ✓ AI configures the simulations and executes large-scale studies
- ✓ Handle problems with your expert insights and its past experience
- ✓ Let it draft reports of work performed, challenges, solutions



# Building a Prototype Agentic Artificial Intelligence Platform for Transmission Planning



- Get an AI Planning Assistant tool into your hands quickly



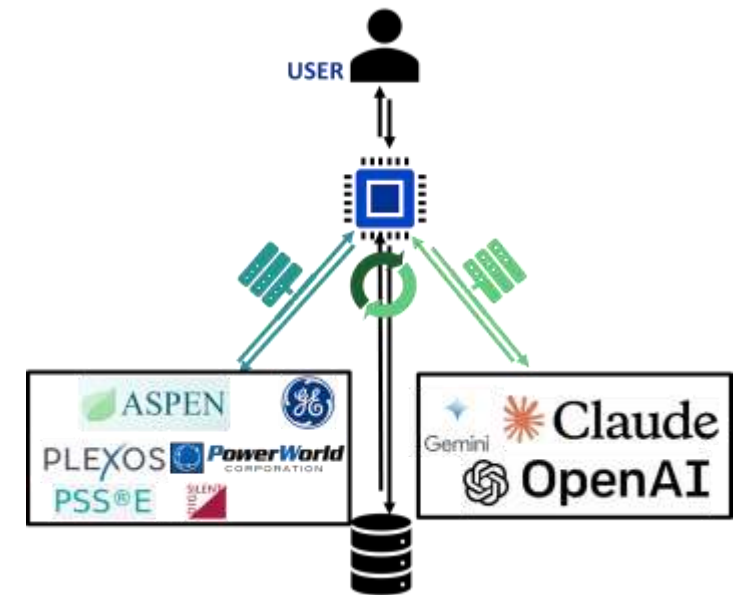
- Demonstrate additional use-cases
- Improve scalability to industrial sized systems
- Implement safety & trust systems



- Integrate with existing planning tasks
- Identify the real challenges, bottlenecks, and limitations



Scan QR  
To Express  
Interest



Contact: [Sean McGuinness](mailto:smcguinness@epri.com)  
smcguinness@epri.com



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