Sandia National Laboratories

Exceptional service in the national interest

PVCollada: A Schema for Exchange of Digital PV System Design Data

Clifford W. Hansen and Stéphane Degré

Sandia National Laboratories, Albuquerque, NM USA
PVsyst SA, Satigny, Suisse

May 12, 2026

SAND2026-20966PE

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia LLC, a wholly owned subsidiary of Honeywell International Inc. for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

U.S. DEPARTMENT OF ENERGY

NNSA

What problem does PVCollada address?

Industry lacks a convention for the digital representation of a PV system

- Although designs are commonly done in a CAD environment there is no convention for describing components or electrical circuits

The lack of a convention costs time and money

- Onboarding of PV systems to a modeling or analytics platform is tedious work
- Limited interoperability among current modeling and analytics platforms

PVCollada provides a capability to exchange digital models of a PV system's geometric, mechanical and electrical descriptions

Outline and Summary

1. What is COLLADA?
2. What is PVCollada?
3. What information can be communicated using PVCollada?

30+ contributors to PVCollada development including:

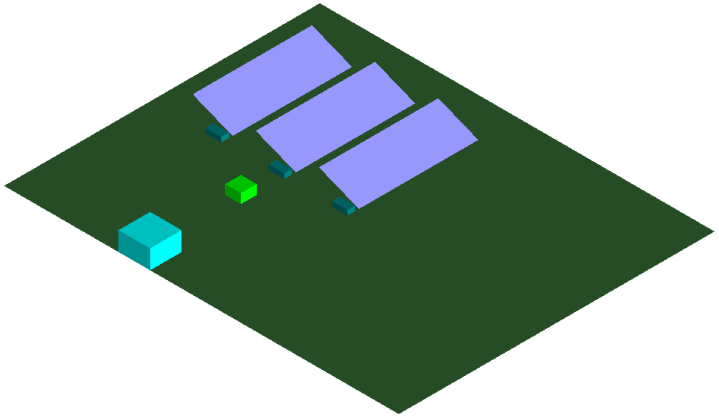
ieco.io ENGIE enurgen PVSYST PHOTOVOLTAIC SOFTWARE

DNV RatedPower A PART OF ENVERUS SOLARGIS PVCASE

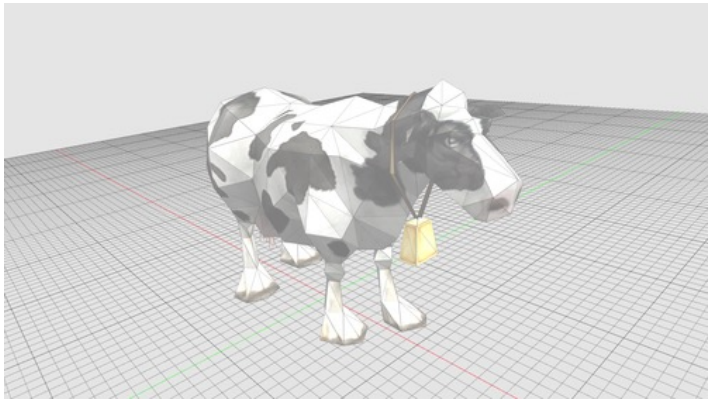
What is COLLADA?

COLLADA is an open, free-to-use XML-based schema that provides an intermediary format for sharing of DC models and related data, such as textures and lighting.

- Identified by the ".dae" file extension
- Latest release August 2008 (v1.5.0)
- Adopted as ISO/PAS 17506:2022 "Industrial automation systems and integration:..."
- Maintained by Khronos Group (copyright shared with SONY)
- Can be read/written by many 3D applications (Sketchup, Blender, Autodesk, ...)



Example images from COLLADA files



What is PVCollada?

In 2022 PVCase and PVSyst agreed on a data exchange format for 3D designs

- Added some PV-specific tags to COLLADA data objects
  - Now called PVCollada 1.0, file extension .**pvc**
  - Modified the COLLADA 1.4 schema
  - Result is not a valid COLLADA file

In 2024, PVCollada 2.0 working group formed

PVCollada extends (not modifies) the COLLADA 1.5 schema

- File extension .**pvc2**
- Describes **physical**, **mechanical** and **electrical** relationships
- Provides tags for **component properties** and **system metadata**

PVCollada can accommodate custom extensions

- E.g., PVsyst extension contains a PAN file

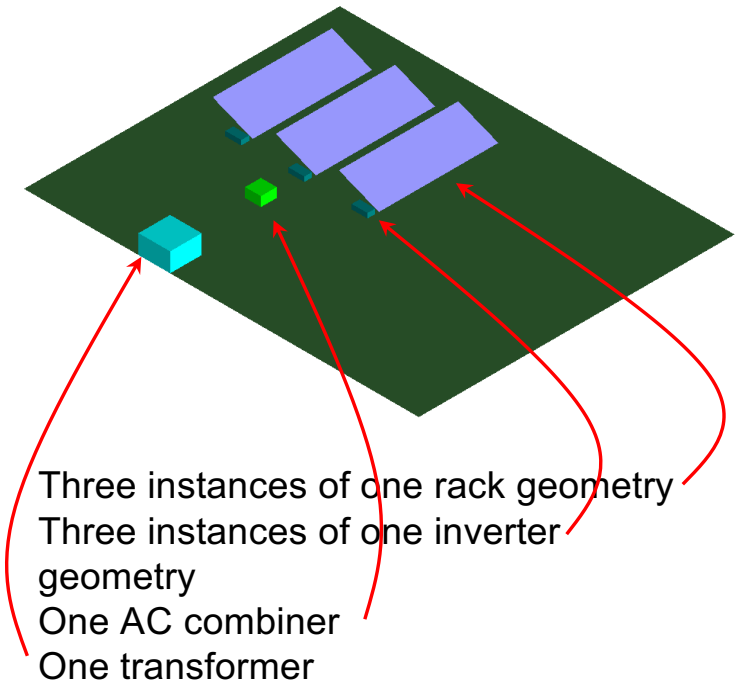
Describing the PV system's physical layer

A COLLADA <**geometry**> provides shape of each object in a local coordinate frame

- A <**geometry**> references to an <**asset**> to connect a shape with component properties

A COLLADA <**instance_geometry**> creates an object in the reference coordinate frame

- Using transformations: <**scale**>, <**rotate**>, <**translate**>

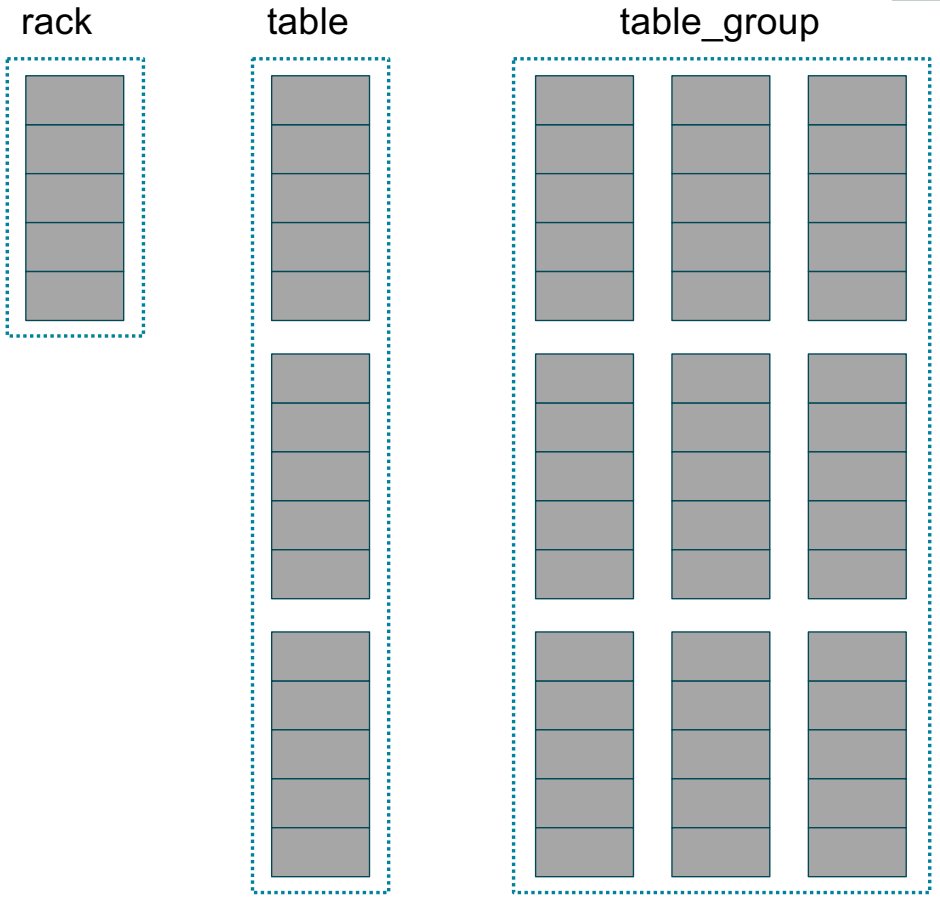


The mechanical layer

The mechanical layer shows which objects should rotate or move in common

- **rack**: coplanar panels
- **table**: mechanically linked racks along a single row
- **table_group**: mechanically linked tables

PVCollada 2.0 does NOT use COLLADA's animation capabilities



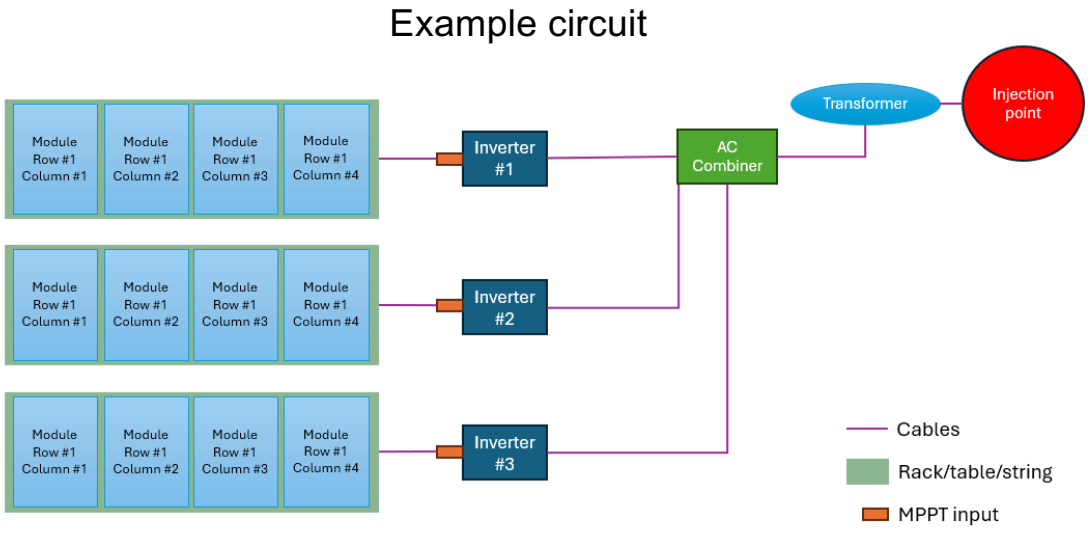
The electrical layer

The <**circuit**> object describes a directed tree of objects, including

- Cables and MPPTs
- Module position in the electrical string

PVCollada 2.0 schema restricts the type of objects that can be connected

- E.g., a MPPT can only be connected with a string or DC combiner



Component properties example: a module <asset>

Enumeration: ‘monofacial’, ‘bifacial’, ‘cpv’, ‘shingle’

Nominal power in W at STC, specified in the tag documentation

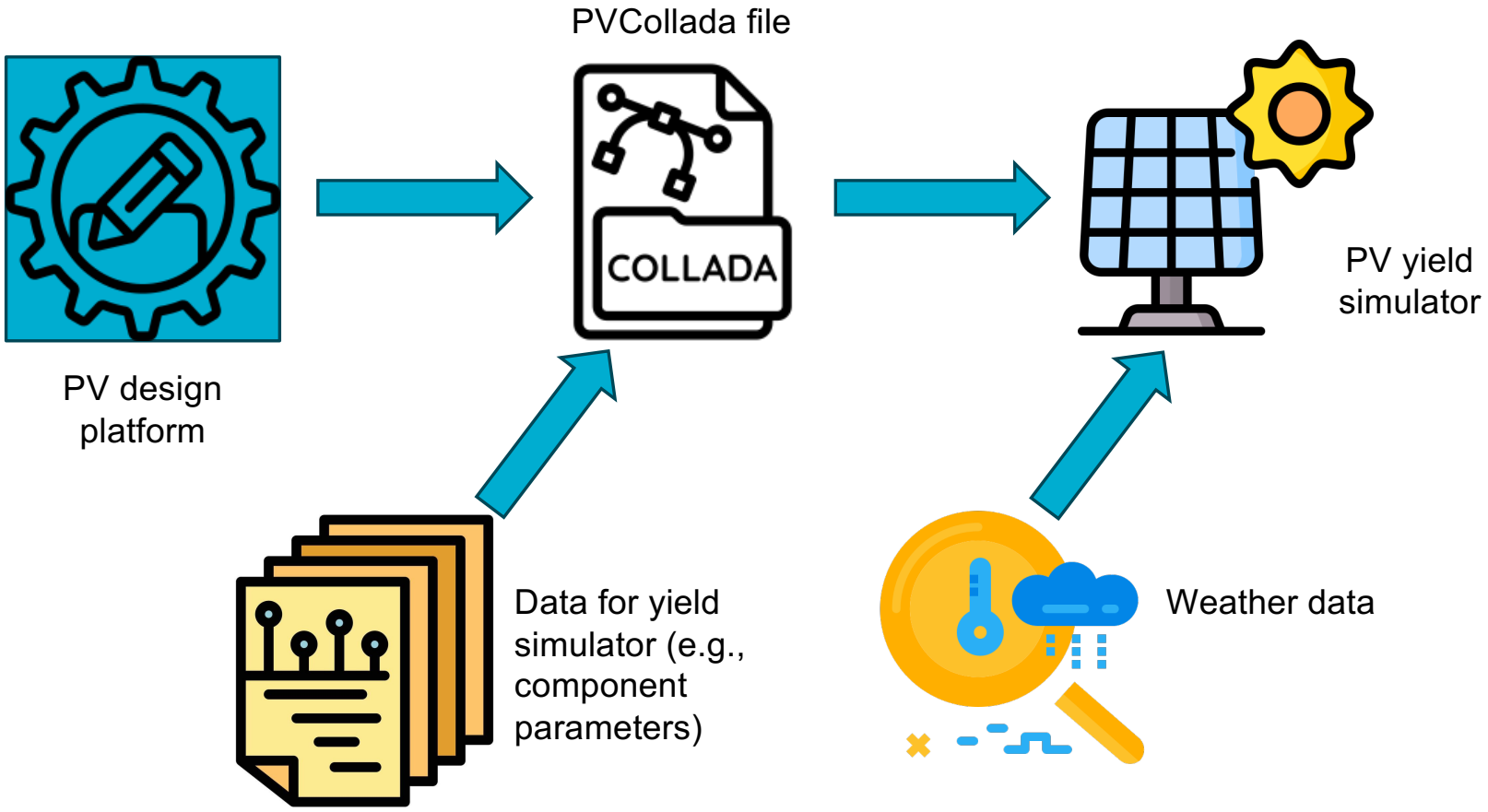
PVCollada schema provides enumerations

Units, conditions are found in each tag’s documentation

Data elements can be optional, e.g., bifacial_factor

```
<pv:module id="ModuleModel1">
  <pv:manufacturer>Generic</pv:manufacturer>
  <pv:name>Generic 400W bifacial</pv:name>
  <pv:module_type>bifacial</pv:module_type>
  <pv:nom_power>400</pv:nom_power>
  <pv:length>1992</pv:length>
  <pv:width>1000</pv:width>
  <pv:depth>6</pv:depth>
  <pv:num_cells>72</pv:num_cells>
  <pv:num_cells_length>12</pv:num_cells_length>
  <pv:num_cells_width>6</pv:num_cells_width>
  <pv:num_cells_series>72</pv:num_cells_series>
  <pv:num_strings>1</pv:num_strings>
  <pv:cell_material>polySi</pv:cell_material>
  <pv:bifacial_factor>0.680</pv:bifacial_factor>
  <pv:t_coef_power>-0.37</pv:t_coef_power>
  <pv:t_coef_isc>-0.3</pv:t_coef_isc>
  <pv:t_coef_voc>49.7</pv:t_coef_voc>
  <pv:i_sc>10.35</pv:i_sc>
  <pv:i_mpp>9.79</pv:i_mpp>
  <pv:v_oc>49.63</pv:v_oc>
  <pv:v_mpp>41.19</pv:v_mpp>
</pv:module>
```

Using PVCollada in a design/modeling workflow



Summary

PVCollada 2.0 provides a capability to digitally represent a PV system

- Physical, mechanical and electrical layers
- Component properties

PVCollada 2.0 can be extended with data specific to a software application

- E.g., a PAN file could be included in a PVCollada 2.0 file.

PVCollada 2.0 is COLLADA-compliant

- Read and display using 3D tools such as Sketchup

PVCollada 2.0 expected to be available summer ~~2025~~ 2026 (soon)

- Schema for legacy PVCase – PVSyst interface (PVCollada 1.0) is available

www.github.com/pvlib/pvcollada.git

Implementing

- Pvsyst (v8.1.4)
- PVCase
- SolarFarmer
- SolarGIS
- PVX.ai

PVMAC Industry Interoperability WG

PVOperations & Maintenance ANALYTICS COLLABORATIVE

What we are hearing

- Onboarding and data readiness affect scalability
- Integration is feasible but fragmented
- Digital Twin definitions vary

A starting point?

PVCollada 2.0 as a candidate foundation

- Structured, spatially aware plant representation
- Bridges design and operations
- Able to host enumerations for state labels, etc.