

ATS New Product Development Progress

What started out as a 5year project to production is still bogged down after 13 years without a proven dam installation. We are stuck because of:

- Government's reluctance to follow its purpose of picking up the risk of supporting unproven technology that industry is unwilling to take on.
- Funding delays. Initial resistance to funding by Iowa government ended up delaying ATS initial testing for 2 years. Projects are funded based on governments time schedules, not when the money is needed.
- Lack of a dam installation puts us in a "catch 22" position we cannot start a profitable business without a "first installation" to get sales. We are stuck !

New technology and purpose for Small Hydro

- Provide an economical way to engage lower head hydro opportunities to become profitable by novel design.
- Better use of the US river system using Small Hydro to produce a distributed power grid.
- Lower cost of hardware Lower cost of installation Lower cost of maintenance provide new venues previously not feasible.

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Unique ATS advantages over existing technology

- Combination in a single housing of turbine and generator avoiding the use of metals (made possible because of the low 7 to 50ft) head. (See Figs. 3 ATS-63 and 2)
- Variable speed, eliminating the use of wicket gates, hydraulic controls and governors.
- Variable speed assures maximum efficiency regardless of head.
- Variable speed allows operation at a higher frequency, greatly reducing the size of copper coils and steel laminations, accounting for the much lower weight, permitting non-metallic housing and pit installation.
- Electronics involved provide instant speed control and turbine optimization without wicket gates and related control hardware.
- Electronics provide instant synchronization, island service and black start capability.
- Combination of the above reduces the weight and footprint to up to one-fifth of a conventional turbine with generator. The ATS-8 installation in the next slide, see Fig 1 generating 40kW, weighs under 200 lb. A 40kW 60 cycle 3 phase generator weighs over 800 lb.
- The much lower weight and footprint of the ATS turbine eliminates the need for complicated civil construction and the traditional powerhouse and allows one-day maintenance.



Fig. 1 ATS-8 ready for installation on Keokuk Dam



Fig. 2 3D print Composite version of ATS-8 in assembly

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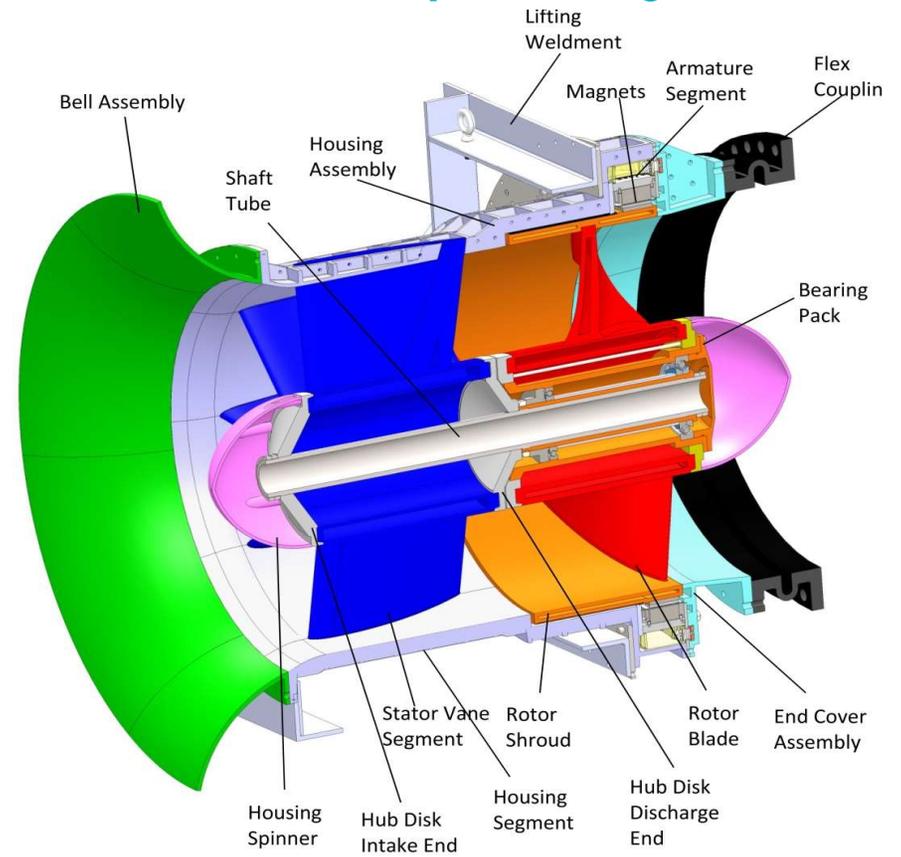


Fig. 3 Section of ATS-63

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Initial industry response

- High level of interest and technical hydro specialists recommendation to pursue concept.
- First question: How many in operation in a dam? And; Where can I see one in operation?
- This underscores the need for a “first installation” but no dam owner could be found to take the risk, until:
- Ameren, the owner of the Keokuk dam is now testing the ATS-8 scale model and will test the ATS-63 after the ATS-8 is shown to operate on a dam.

ATS Development Delays

- Iowa state funding approval for University of Iowa testing of ATS-8 took 2 years – 2009-2011.
- FOA and DOE SBIR I, II and IIA applications, operating on their schedule instead of ATS progress need caused delay of (2 years). 2012 – 2014
- ATS found dam operator (BPU, Brainerd MN) allowing an ATS-63 test installation on the Mississippi Dam providing all modification and installation cost would be borne by ATS until proven- 3 years 2015-2018
- The turbine was installed and run, however the need for a correction arose at the time of Covid, delaying operation to late 2019. However BPU cancelled all access for further testing without paying for improvements of \$900,000 paid by ATS, and claiming insufficient progress.

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Fig. 5 Completed ATS-63 turbine/generator



Fig. 6 Installation in the Brainerd Dam

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Why industry is not encouraging innovative technology implementation?

- Complacency and fear of the new in an arch-conservative industry, especially the use of DC used in electric cars uses exactly the same concept ATS uses. If this were not the case, the equivalent 40kW motor would weigh 800 lb. and Elon Musk would be building electric Sherman Tanks.
- After 2014, DOE focused on dam and River Reach sites and tried to “classify” the various design approaches and applications bringing in recreational alternative uses of “New Development” sites without having the hardware that will accomplish this. DOE, fund an experimental installation!

What can government and industry do better promote novel technology?

- DOE to promote and Fund ATS installations with conditional loans to first users and make ATS a part of the project having the flexibility to operate on the business schedule and not the FOA schedule of DOE to avoid gaps in progress.
- Industry and government must Invest in new technology looking for the long term; these projects of non-fossil power generation are by nature long term projects.
- ATS can then bring out the full capacity of more new ideas that are now squashed because of lack of funds.

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As in the last slide, ATS can bring out the full spectrum of more new ideas that are now squashed because of lack of funds. For example, in the case of ATS, there are plans for:

- Further developing, constructing and testing the ATS-16 and ATS-32 turbine/generators using 3D printed composite components and power electronics, covering 20 to 850kW filling in the ATS line.
- Developing lamination-free power generation that will reduce system weight even more). The Chinese are doing this with generators but ATS can apply this with ATS already worked-out plans.
- Develop and test a hybrid hydro generation system using power electronics already existing on the variable speed ATS turbine/generators. A 1MW generator can produce 1.5MW during diurnal variations by storing power and returning it in a time of high demand. The turbine is always fully loaded. This concept becomes more economically feasible with the future drop in battery cost.

All of these developments will further lower the hardware and installation costs, much smaller footprint and much faster installation times otherwise not applicable.