GENERAC®
INDUSTRIAL POWER

WHITE PAPER

Remote Cooling Systems

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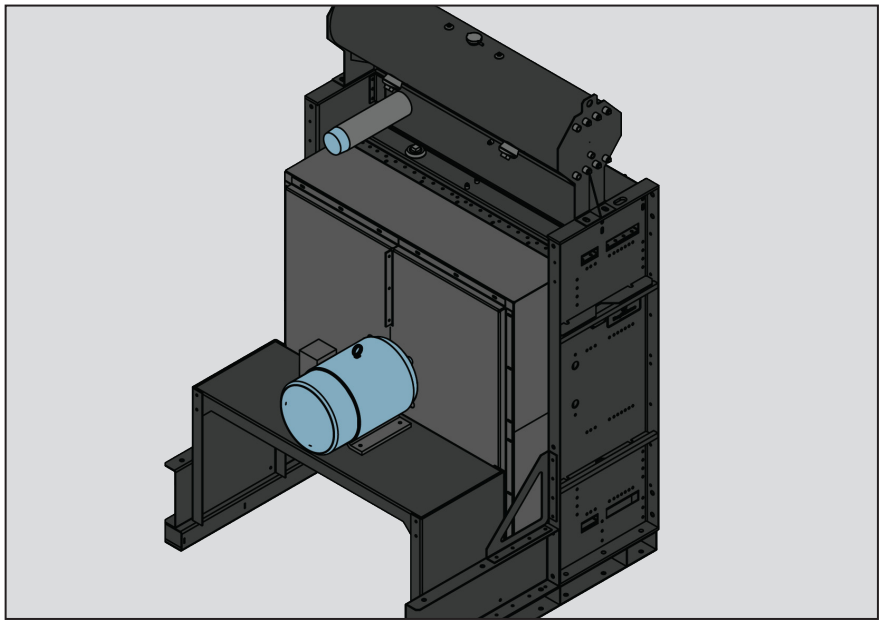
INTRODUCTION

When the complete cooling system or its partial components (radiator, heat exchangers etc.) are designed external to the engine generator set, then it is known as a remote cooling/radiator systems. Remote radiators are used in several applications, such as heat recovery or for other technical reasons where a traditional unit mounted radiator is simply not feasible. Lately, more businesses are considering backup power as a necessity for their manufacturing plants, large real estate buildings etc. and one way they can maximize the investment made on their power unit is by utilizing the byproducts of power production for various other purposes. A custom designed remote radiator can facilitate the use of the heat emitted by the generator system in order to accommodate the heating needs of the facility.



CONTINUED

Engine-driven generator systems traditionally utilize a unit-mounted radiator for transferring the heat from the engine to the coolant and while many generator sets have an engine-mounted radiator; it is quite common for larger sets, particularly those located indoors, to use a remote radiator system. Most commonly, the remote radiators are utilized when the generator is being installed physically within a very tight space or in the engine room where the required cooling airflow for the generator is not possible to meet. As the engines get larger, or the installations become more complex, the vertical core and close-coupled fan arrangement may no longer be the best fit. This paper would provide insights on the remote radiator sizing and installation considerations.

INSTALLING A REMOTE COOLING SYSTEM

Remote-mounted radiators add tremendous flexibility to the installation where a close-mounted unit simply will not work and the specialized needs may drive very different radiator configurations. Unlike a generator set that comes from the manufacturer with the radiator already installed on the base, a remote radiator system requires the final assembly of the cooling system to be undertaken onsite. The process requires specialist knowledge regarding sizing, pipe dimensions, radiator types and sizes, mounting, loading, etc., to install and should only be completed by a trained professional. The following items must be considered before installing a remote cooling system:

- **Coolant Piping** – Pipe lengths and the engine manufacturer's requirements for coolant flow will determine the diameter of the piping. Connections to the engine should have flexible pipe sections to avoid engine vibration being transmitted to the piping system.
- **Radiator Selection** – Radiators are available with single and split cores. Split cores allow for the cooling of two systems.
    - **Single core** – If the generator set engine is naturally aspirated or has a turbo charger that is not cooled.
    - **Split core** – Many larger generator sets and those that most commonly require remote radiator systems incorporate turbo aftercoolers. Aftercoolers use air/water heat exchangers and require an additional core in the radiator to cool the coolant.
- **Pumps** – The engine manufacturer incorporates a pump to manage the coolant flow to a radiator mounted adjacent to the engine. A remote radiator system will be much further from the engine and may require an additional pump to ensure adequate coolant flow. For radiators mounted above the engine, such as on a roof, the installer will have to know the necessary lift of the pump in addition to the flow requirement.
- **Ventilation** – Although mounting the radiator remotely will remove a high-percentage of the required airflow out of the generator location, the system designer still must calculate the ventilation requirements to manage radiated heat and combustion.
- **Expansion Tank** – The primary function of the expansion tank is to allow for the thermal expansion of the coolant. Placement, size and location of the expansion tanks are also extremely important. Systems that use a remote expansion tank must include a deaeration chamber near the engine outlet with vent lines extending to the expansion tank. Since the full coolant flow does not pass through the expansion tank, there is little opportunity for entrained air/gas to escape the flow. That opportunity must be created by including a deceleration zone in the flow path. The expansion tank must be installed at the highest point in the entire cooling systems.

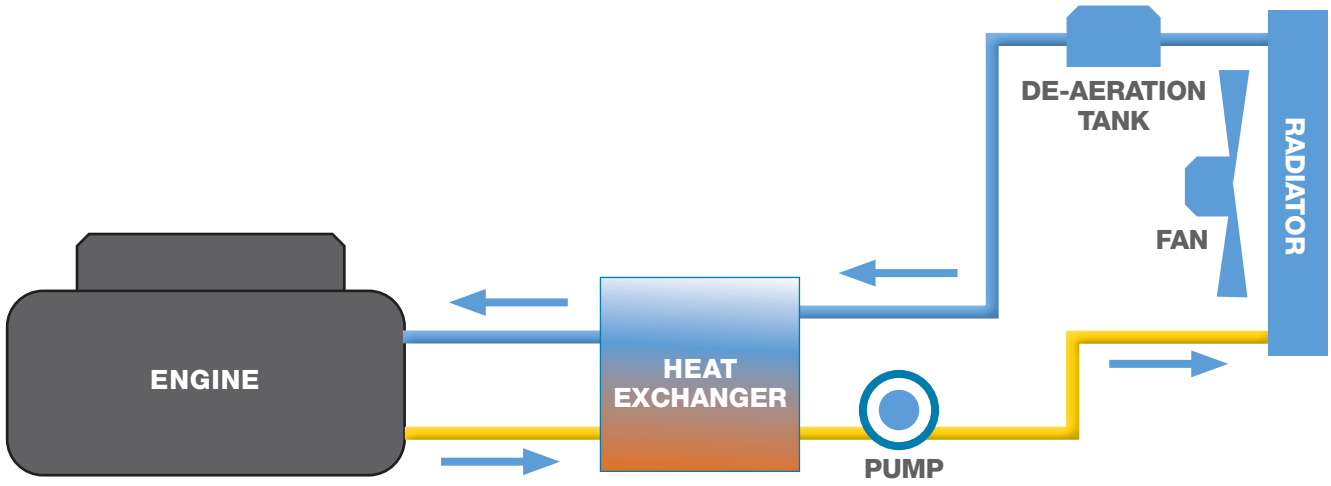


Figure 1: Typical Remote Colling Arrangement with Heat Exchanger

SIZING CONSIDERATIONS

When determining the size of the radiator and its accessories, there are several other factors to consider. Remote location of a radiator might result in the radiator requiring an increased elevation. However, if the height of its location exceeds the allowable height specified by the engine manufacturer, the setup can negatively affect the engine performance and physically deteriorate the engine parts. To solve the altitude effects, the use of either a heat exchanger, a hot/cold well system or combination of both is required. Although this raises the overall cost of the system, it does allow the use of a radiator at a higher elevation than the engine.

CHARGE AIR COOLER SIZING CONSIDERATION

Charge air cooler sizing considerations are as follows:

1. Heat rejection
2. Temperatures in and out of charge air cooler
3. Maximum allowable temperature into the engine intake manifold
4. Minimum allowable temperature into the engine intake manifold

Depending on the type of charge air cooler, other accessories like a fan or heat exchanger may need to be designed or selected accordingly.

CONCLUSION

Remote radiator/CAC cooling is a trend that we are seeing applied more often, especially with larger power units. Also in contrast to the engine-mounted radiators, the remote radiators impose added restrictions that can be in a form of modified coolant flow as a result of additional piping and fittings that are required to install the radiator remotely. While designing a vertical remote radiator, the radiator should be positioned such that the prevailing winds do not impede the fan airflow or cause the heated air to recirculate through the radiator. The horizontal remote radiators are not affected by the wind however, they may require protection from natural elements such as rain, snow etc.

AUTHOR BACKGROUND

Muhammad Armaghan is a Product Manager at Generac Power Systems. He is responsible for the Global Industrial Generator product line. Armaghan has experience working in industrial power generation markets and has supervised several multi-million-dollar projects throughout United States. These include power plants, healthcare facilities, data centers and municipal projects. Armaghan has also worked closely with consulting and specifying engineers, as well as general and electrical contractors and end users