DEEP CASINGTOOLS

PDM Drilling Motors	Risk (Impact)	TURBORUNNER™	Risk (Impact)
Vibration – with a PDM drilling motor significant low frequency vibration will be present at the end of a completion string during reaming operations. This may damage the completion as a result. This vibration will increase as weight is applied to the bit.	(H)	Turborunner™ tools create little vibration during operations. Any vibration created by the Turbo-runner™ tools will be high frequency and as such will not be transmitted up the string.	(L)
Reactive Torque - significant reactive torque will be present during reaming operations when a PDM drilling motor is used. This may damage the completion string. Torque will significantly increase if the motor stalls during reaming operations. Torque will be applied to the completion system erratically more like an impact wrench due to its low frequency.	(H)	Turborunner™ tools create little reactive torque during operations. Torque for the reamer bit is not transmitted to the completion string.	(L)
Operating Pressure – operating pressure of a PDM can be sufficient to activate hydraulic set completion tools higher up in the string. ECD may also limit the circulating rate which will be required to operate the PDM motor effectively.	(M)	Turborunner™ operating pressure can be as low as 200 psi and pump rates as low as 2 BPM. The tool's operating envelope can be tailored to meet specific well applications.	(L)
Pressure spikes – the operating pressure of a PDM will spike if the tool stalls. This will have a knock effect on pressure set components in the completion string.	(M)	Turborunner™ operating pressure will DROP if the motor is stalled.	(L)
Rupture Disk – the use of a rupture disk to prevent PDM drilling motor pressure spikes setting completion components limits the tool's continued use. If the rupture disk is activated the tool's functionality is immediately lost.	(M)	As the pressure to operate Turborunner™ tools is finite and the pressure will drop during stall, there is no need for a rupture disk which allows fluid into the annulus above the tool when activated.	(L)
Weight on bit to ream – as a PDM drilling motor rotates at lower speeds it requires higher torque to transfer energy into reaming. To do this weight needs to be stacked down on the bit which may be a challenge for many completion and liner applications.	(M)	Turborunner™ tools operate at high speed, up to 2400 rpm. The speed at which the bit rotates will effectively transfer the energy without the need to apply large loads to the bit.	(L)
Risk of side track - a drill bit used to ream and re-establish hole conditions, has the functional capability to bite the formation and effect a side-track while reaming in a completion.	(H)	Risk of side track is minimal with the Turborunner™ reaming shoe's non-aggressive profile.	(L)
Effective tool life – the use of an old second hand PDM drilling motor limits the reliability of the tool. The effective working life of the tool can only be estimated. Hence the tool's functionality may be lost before completing reaming operations.	(H)	Turborunner™ tools are non-elastomeric and bearings are new. The tools will deliver reaming capabilities for several days, and have been tested to deliver >20 hours.	(L)
Temperature and Chemical effects – PDM motors utilize elastomeric components, utilization is limited due to the effect of temperature and the corrosiveness of the fluid used to operated them.	(H)	Turborunner™ tools are non-elastomeric and as such they are suitable for use in high tempera-tures applications and corrosive fluid regime.	(L)